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Economic Behaviour Of Developing Country Farm-Households: Measures Of Rates Of Time Preference, The Use Of Cattle As Buffer Stock, and The Endogenous Evolution Of Land Rights

By

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The undersigned certify that they have read, and recommend to the Faculty of Graduate Studies and Research for acceptance, a thesis titled ECONOMIC BEHAVIOUR OF DEVELOPING COUNTRY FARM-HOUSEHOLDS: MEASURES OF RATES OF TIME PREFERENCE, THE USE OF CATTLE AS BUFFER STOCK, AND THE ENDOGENOUS EVOLUTION OF LAND RIGHTS submitted by GODFREY KUNDHLANDE in partial fulfilment of the requirements for the degree of DOCTOR OF PHILOSOPHY INAGRICULTURAL ECONOMICS.

ABSTRACT

In most economic systems, most decisions regarding resource allocation are made at the level of the individual economic units (e.g. consumers, landowners, and households). Studies that contribute to an improved understanding of household behaviour will sharpen the understanding of economic outcomes, and could lead to the design of better economic policies. This dissertation investigates three issues that are important for rural and development policies in developing countries.

In Chapter 2 empirical measures of rates of time preference (RTP) for rural households are developed and determinants of the estimated RTPs examined. RTPs were estimated to be 17.3% for a delay of 1 year and 65.9% for a delay of 10 years for consumption of maize, under the assumption that RTPs vary with time (corresponding values for firewood are 51.7% and 52.1%). The RTPs are 38.2% for maize and 55% for firewood, if it is assumed that individuals discount exponentially. A person's age was found to increase the estimated rate of time preference.

In Chapter 3 the asset buffering behaviour of households, specifically the role of cattle sales, is investigated. The ability to accumulate financial assets, livestock, man-made and natural assets is potentially important to households' ability to "smooth" consumption when their incomes are temporarily low. The study reported in Chapter 3 explores the empirical significance of cattle sales as a consumption smoothing tool. For communal lands in Zimbabwe, cattle sales do not appear to play a big role in helping households cushion their consumption when their income is temporally low due to droughts.

Chapter 4 explores the determinants of the evolutionary changes in land rights, away from communal tenures systems toward a more individualised system of land rights. As conditions become conducive, more rights regarding control and use of land, are appropriated by individual households out of the community domain. A model of endogenous property rights is presented and used to explore the determinants of the land rights enjoyed by communal lands farmers in Zimbabwe. The results suggest that high costs of defining and enforcing land rights impede the process of individualisation of land rights, while increases in household wealth enhance it.

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CHAPTER 1

Household Economic Behaviour, Agrarian Institutions and Economic Policy

Introduction

In most economic systems, many decisions regarding resource allocation are made at the level of the individual economic units (e.g. consumers, workers, investors, owners of land, and households). Economic theory can help explain how and why economic agents make resource allocation decisions. For example, it explains how farm households make investment decisions and how their choices are affected by changing prices and incomes. The theory of consumer choice, on which the explanation is based, assumes that consumers make choices in a rational way, interpreted to mean that they choose goods or engage in activities to maximise the satisfaction they can achieve, given the constraints imposed on them (e.g. a limited budget).

Also of importance to the functioning of an economy are the interactions of economic units, and the institutions that are required to guide the interactions in order to maximise the net benefits that may result. Economic theory can help explain, for example, why and how agricultural societies control access to land and the ways in which land may be used. By studying the behaviour and interaction among households, economic analysis reveals how agrarian institutions (markets and land tenure systems) work and evolve, how they differ from one another, and how they are affected by government policies, and overall economic conditions.

Since the effect of many of the most important policies is ultimately determined by the response of economic agents, understanding the behaviour of households, consumers, and workers will facilitate the formulation of policies that are likely to be more effective for fostering efficient utilisation of resources, and economic growth and development. This is particularly relevant for policies designed to foster economic growth in the agricultural sector of developing countries, where the rural household is the relevant economic agent. Policies and other institutional innovations that are compatible

with individual incentives are more likely to be effective and to achieve their intended objectives.

Until recently, analyses of the economic problems of poor countries and the proposed policies for solving problems have tended to focus mainly at the national level and on aggregate economic indicators such as the level and growth rate of national output, unemployment, interest rate, and inflation. Since these variables are generated in aggregate markets for goods and services, and for labour and corporate bonds, better understanding of how these markets work requires an understanding of the behaviour of households, consumers, workers and investors who make up these markets. In developing countries, where rural areas are, in general, not well integrated into the national (market) economy, the design of rural policies to achieve rural development can benefit from a more complete understanding of the material and behavioural determinants of households and institutional responses. The absence of some markets and imperfections (due to high information and transactions costs, etc) leads to interdependences of consumption and production decisions. Household consumption preferences and prices of consumer goods affect production decisions. Therefore, the standard neoclassical analysis that assumes perfectly competitive markets and separability of consumption and production decisions is not useful in analysing economic behaviour of households in rural areas in developing countries. Household production models presented a better analytical approach as they allow a joint consideration of household production and consumption.

In the past decades, much has been written about rural households in Africa, and much policy advice has been given based on these writings, but little of this advice has an empirical basis (Kinsey, 1995). Where reference to empirical data is made, the data are usually from secondary sources and are highly aggregated. The quality of analysis for policies intended to lead to rural development may, be improved by improving the quality of data on which analysis is based. The appropriate data for these purposes are data collected at the household level, that capture both the static characteristics of households and the dynamic aspects of economic, social, institutional, technical and environment change.

This dissertation examines three issues that are relevant for the design of policies related to rural development, and that have received some attention in recent years in the

economic development literature. The first, described in Chapter 2, is the magnitude of the rates of time preference (RTPs) implicit in intertemporal decisions of rural households, and the determinants of these implied RTPs. Empirical measures of the RTPs are developed from stated preference data. The second issue concerns how, and how well, rural households insure their consumption in the face of income risk and the lack of contingency markets. In Chapter 3 the role of cattle as a buffer stock for mitigating income shocks is assessed using panel data collected from the rural areas in Zimbabwe. The third issue examined, which is the subject of Chapter 4, is the issue of property rights for the land resource. While changes in land tenure have long been regarded as a potential source for achieving agricultural development (since land tenure affects attitudes and motivations that lie at the root of the economic behaviour of farmers), little effort has been invested in understanding the process under which property rights systems emerge and are maintained. A model of endogenous property rights is developed and applied to the communal lands in Zimbabwe.

The remainder of this chapter briefly summarises the issues of time preference, income risk and asset accumulation, and land tenure, and highlights the importance of understanding micro-level behaviour and the need for adequate representation of individual preferences in the formulation of economic policies.

Time Preference and Intertemporal Allocation Decisions

Individuals generally tend to exhibit a preference for present consumption over future consumption when making intertemporal allocation decisions. This phenomenon is referred to as time preference. The explanations for time preference suggested in the literature include the argument that future consumption is discounted in order to reflect the uncertainty of realising consumption in the future. Individuals have also been observed to discount future consumption even when its perfectly certain to occur just because they prefer current consumption more, and this is referred to as impatience or pure time preference (Pigou, 1932). The discount rate used by individuals to evaluate future consumption (to determine its present value), is referred to as the rate of time preference.

The rates of time preference used by individuals to evaluate intertemporal allocation decisions have important implications for savings and investment decisions, and for the management of natural and environmental resources. When individuals have high rates of time preference, future consumption will be discounted heavily, thus more resources will be used to provide current consumption, and less will be saved, which may lead to underprovision for the future. High rates of time preference may also result in lower investment in capital and other productive assets (including natural and environmental resources), resulting in low levels of wealth accumulation (Deaton, 1991). Low levels of savings/ wealth accumulation may compromise the ability of households to provide for secular and cyclical fluctuations in their income.

Since many decisions with a bearing on the success of rural and development policies depend to considerable extent on the discount rates used by farm households, there is need for research to provide estimates of the magnitude and the determinants of farmers' discount rates.

Income Risk and Asset Accumulation Decisions of Rural Households

The ability to accumulate financial assets, livestock, man-made and natural assets, and human capital is potentially important to household production and consumption. Chapter 3 of this dissertation focuses on the investment behaviour in one of these assets: cattle, with particular attention on the use of cattle sales to protect household consumption from unexpected income shocks. The behavioural assumption underlying the analysis is that households engage in intertemporal asset accumulation behaviour to optimise the trade-off between consumption today and consumption in the future.

It is assumed that households' desire to insulate their consumption from income shocks and the unavailability of contingency markets is a major driving factor underlying their asset accumulation behaviour. Since savings provide resources that are available in the future when uncertainties are resolved, the decision to save is closely related to the nature and extent of uncertainty – the precautionary motive for saving (Gersovitz, 1988). For example, households may choose cattle as the main vehicle for asset accumulation because they are a liquid asset (can be sold to obtain cash to purchase food), as well as

having high expected returns in the form of offspring, the supply of milk and other products, and for their role as a productive input in farming. The unavailability of opportunities for insurance and borrowing increases households' exposure to risk thereby intensifying the precautionary savings response.

There is considerable evidence of high degrees of income uncertainty (e.g. Scoones, 1996) and absence of contingency markets in rural economies (the absence of these markets is attributed to of the widespread problems of moral hazard, information asymmetries and deficiencies in the ability to enforce contracts Stiglitz, 1985; Townsend, 1995). This suggests that asset accumulation to mitigate these impacts is an overriding concern for many households, forcing households to under-invest in productive assets. When a household relies on a productive asset to smooth consumption, frequent income shocks may force the household into a cycle of under-investment in productive assets (Murgai, 1997), and may have some consequences on future income (Udry, 1995). Thus, understanding the determinants of investment in different assets and the precautionary savings behaviour is very important for rural and development policies.

The Economic Significance and Evolution of Land Right

Even in situations where communal ownership of the land is imposed by the state or other authorities, the cultivation and possession of specific parcels of land remains with the individual households. As conditions become conducive, more rights regarding the control and use of the land are appropriated by individual households out of the community/ group domain. There is a need for rigorous quantitative research that would help increase our understanding of the evolution of land rights.

The property rights and land tenure literature discusses the importance of clearly defined rights in assets/ resources in influencing effective use of resources and the functioning of an exchange economy. The structure of property rights affects resource use and the level of output through its effect on the incentives faced by resource owners. Well-defined property rights allow owners to capture the stream of benefits generated by their resources, thus providing incentives for their efficient use, and the undertaking of investments to enhance the quality of resources. Clear assignment and enforcement of

property rights also supports the development and expansion of exchange opportunities for economic agents by lowering the costs of exchange.

The literature provides guidance for assessing the consequences of various structures of property rights existing at a point in time, but much less effort has been directed at the question of how property rights structures come into being (Anderson and Hill, 1975; Liebcap, 1989; Feder and Feeny, 1991 and Besley, 1995 are notable exceptions). There is need for research on the evolution of property rights that takes full account of the preferences of individual right holders, the opportunities they face, and the institutions of collective action available to them. Institutions do not exist independent of individuals' incentives to set them up. In fact, they emerge from the choices of rational economic agents. The study of the behaviour of economic agents needs to be extended beyond the choice of production and consumption to include institutions, especially when studying the economies of developing countries, where the presumption of exclusive, transferable, alienable and enforceable rights is frequently incorrect (Feder and Feeny, 1991). Since the same behavioural assumption of utility/ wealth maximisation is used to underpin the assessment of choices, the analysis may be carried out using the tools of standard economic theory and property rights theory.

According to property rights theory, changes in land rights are motivated by increases in land values because of scarcity, the opening of new markets, technical change, and authority decisions. Chapter 4 describes some linkages between technical change, land values, and the demand for changes in land rights, and outlines a model of endogenous land rights. The model makes it possible to investigate the effect of landholders' actions, for example, investment tree planting and other tenure securing activities, on the type of rights enjoyed by the landholders.

The insight that may be gained from this type of research is that when considering the implementation of institutional changes (e.g. property rights reforms) it is important to ensure that the new institutions are compatible with individual incentives to maximise wealth and to abide by the new rules and regulations. Furthermore, the process of property rights reform should be flexible and incorporate landholders' choices, if it is to succeed and achieve the goals it is set out to accomplish. In the end the emergent system of property rights should be one that is complementary to local rules and embedded in

local customs, and is cost efficient in its enforcement. It has been suggested that property rights designed by external authorities, remote from the actual potential users, are less likely to be efficient (in sense of lower cost solution) than rules set by the users themselves (Libecap, 1989; Ostrom, 1990). Property rights reforms are more likely to succeed if they are implemented as a result of the demand by resource owners, otherwise the large amount of resources that usually go into exercises will be wasted. For example, in Kenya, a significant number of titles that were generated at high costs have lost their value as landowners failed to keep them updated (Place and Migot-Adholla, 1998).

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CHAPTER 2

Empirical Measures and Determinants of Individual Rates of Time Preferences: A Case Study of Communal Lands Households in Zimbabwe

Introduction

In decisions that involve time, economic agents are observed to generally exhibit a preference for present consumption over future consumption of an equal amount. This means that when making intertemporal decisions, consumers discount future utility. The uncertainty associated with the realisation of consumption in the future is cited in the literature as one of the reasons why individuals may discount future consumption. Also, individuals have also been observed to discount future consumption even when it is perfectly certain to occur simply because they prefer current consumption more. The rate at which rational individuals, acting under certainty, discount future utility is called the pure rate of time preference (RTP). Preference for present consumption over future consumption resolves itself into preference for present income over future income (Fisher, 1930), and as a result discounting costs and benefits plays a crucial role in the evaluation of activities whose outcome involve a temporal dimension.

The discounting of the value of future outcomes is important for formal analyses and assessments of environmental projects and policies, and for the informal evaluation of investment decisions by households. For example, the decision by a farmer regarding the choice of soil conservation measures - cultivation practices, vegetative or mechanical barriers - involves value comparisons between present and future costs and benefits. If the future is heavily discounted, investments that have near-term benefits and long-term costs (e.g. exploitation of natural forests and land intensive production systems) become more attractive and investments that have near-term costs and long-term benefits (e.g. reforestation and afforestation, and soil conservation) become less attractive. However, while a lower discount rate may have the direct effect of increasing the level of environmental preservation (reduced rate of resource exploitation), it may indirectly

increase the demand for resource inputs through increased demand for capital; and lower the real cost of capital which moves more resource development projects into the profitable range compared to when higher discount rates are used for evaluating projects. Thus, the relationship between the discount rate and the rate of resource use/ level of environmental preservation is non-monotonic, making it impossible to a priori predict the net effect of lower discount rates on the level of environmental preservation (Krutilla, 1967; Krautkraemer 1988).

Most farm decisions involve some element of choice between present and future income. Farmers implicitly assess future costs and benefits, unlike those evaluating large projects for funding purposes (e.g. banks, government departments, the World Bank, etc.) who do it more explicitly. The implicit rates of time preference that farmers use are often not known, and are difficult to assess. However, given that many decisions with a bearing on the success of rural and development policies depend to considerable extent on the discount rates used by farm households, there is need for research to provide estimates of the magnitude and the determinants of farmers' discount rates.

The importance of personal discount rates in influencing individuals' decision has been demonstrated. For example, Cuesta and others (1994) found that individual discount rates were important in influencing Costa Rican farmers' choice of soil conservation measures (cultivation practice, vegetative barriers or mechanical structures). Zuhair (1987) reports that personal discount rates influenced Sri Lankan cash-crop growers' decisions about when to harvest their crop, in a situation where waiting a few more days to allow the crop to fully ripen would result in higher value for the crop. Pender's (1991) observed discount rates ranging from -18 % to 119 % per year, with a median over 50 % for Indian farmers, and Street (1990) found rates of time preference with a mean of 234.4 % per year with a median of 75 % for Haitian tree planters

Rates of time preference may reflect many factors; recent research findings suggest that there is no single unique rate in any setting (Thaler, 1981; Cropper et at 1991; Luckert and Adamowicz, 1993). An individual's discount rate may be a function of his/ her life-cycle position, income, and other factors. Furthermore, different types of goods may be discounted using different rates; and the length of the time period a person has to wait to realise the future outcome may also influence the discount rate.

The study described in this chapter seeks to provide some estimates of the RTPs of rural households in the communal lands in Zimbabwe and to examine the determinants of the estimated RTPs. The hypotheses implicit in the standard discounting model that RTPs are invariant to the type of good considered, and that individuals discount future consumption at a constant exponential rate are also tested.

Theoretical Model

In this section the analytical framework used to guide the empirical analysis reported below is developed based on the tenants of consumer theory, which predicts that a consumer will allocate his/ her means such that the marginal utility of an additional unit of consumption is the same in each period. The framework explores how an individual values future consumption or use of a good under conditions of certainty.

The problem of demand for present and future consumption can be studied within the framework of a rational consumer faced with a consumption plan (stream of future consumption) which is optimal with respect to the consumer's time preference structure. If the consumer's preferences satisfy certain regularity assumption (completeness, transitivity, non-satiation, reflexivity, continuity, and convexity), the preferences in any time period can be represented by a utility function $\mathbf{u(x_t)}$ where x is a vector of consumption goods, and t is the period in which actual consumption takes place; and indifference curves have the usual shape. Koopmans' (1960) utility-theoretic[1] definition of time preference leads to a representation of the intertemporal utility function $\mathbf{V(u(x_0), u(x_1),\ldots,u(x_t))}$, as a discounted sum of the stream of levels of utility associated with consumption in every time period.

By assuming properties such as continuity, intertemporal separabilty, sensitivity, and stationarity for the utility function, Koopmans defines a utility function that can be used to describe consumers' intertemporal preferences. For consumption over the time period T the consumer's allocation problem is solved through maximising the following intertemporal utility function:

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[1] Koopmans argues that the use of money expenditure on consumption (even when prices are adjusted for inflation) is not suitable in a precise definition of time preference due to changing prices, demographic changes etc.

$$V(c_t) = \sum_{t=0}^{T} \frac{u(c_t)}{(1+\delta)^t} \quad 0 \le \delta \tag{1}$$

where δ is a constant discount rate/ rate of time preference, c is the level of consumption in each time period t, and **u(c)** utility received in each time period. If we assume for a moment that future consumption is concentrated at time t, the consumer maximises intertemporal utility by discounting future utility at the rate of time preference. In accordance with standard utility theory, the optimal choice for present and future consumption is when the marginal rate of substitution between present and future consumption is equal to the ratio of the marginal utility of a sure prospect of an extra unit of consumption t years from now to the marginal utility of an extra unit of current consumption. This is illustrated in equation 2:

$$\frac{dc_t}{dc_0} = -\frac{\frac{\partial u(c_t)}{\partial c_t}}{\frac{\partial u(c_0)}{\partial c_0}} = -\frac{u'(c_t)}{u'(c_0)} \tag{2}$$

where $\mathbf{u'(c_0)}$ marginal utility of current consumption and $\mathbf{u'(c_t)}$ marginal utility of consumption in period t. From equation 2, the expression $\frac{u'(c_t)}{u'(c_0)} - 1$, represents the rate (rate of time preference) by which future utility is discounted to make it comparable with present utility if consumption is spread over two periods. Assuming that people discretely discount future consumption at a constant rate, the marginal rate of substitution between present consumption (c_0) and consumption at time period t (c_t) can be written as:

$$\frac{dc_t}{dc_0} = (1+\delta)^t \tag{3}$$

Some Issues Concerning the Rate of Time Preference

Interpretations of economic theory suggest that individuals have a unique and constant rate of time preference at any given point in time. This assertion seems to be contradicted by empirical evidence and by results from experiments involving monetary payoffs (Loeweinstein, 1987; Thaler, 1981), and experiments involving programs that save lives at different points in time (Cropper et al, 1991). The evidence suggests that the rate of time preference varies with the length of the time, and that individuals use different rates of time preference to evaluate different goods (Luckert and Adamowicz, 1993). Also, rates of time preference may vary across individuals.

Studies to determine the pattern of rates of time preferences applied over time horizons of varying lengths, for evaluating different types of goods, and the rates of time preference used by different groups of people are important because different patterns will lead to different policy conclusions. Also, if rates of time preference vary depending on the context, different measures of the rate of time preference will have to be used according to the particular circumstances.

Length of the Time Horizon and the Rate of Time Preference

A general assumption underlying the discounting model is that the discount rate is constant in time. In an important article, Strotz (1956) showed that preferences may sometimes exhibit time inconsistency. That is, as time advances people generally tend to act more myopically in the present than they had previously planned. Empirical studies involving hypothetical money payoffs and lives saved at different points in time also suggest that that the discount factor used to adjust future outcomes to their present values vary with the length of the time horizon (Thaler, 1981; Benzion, et at, 1989; Cropper et al, 1994). These studies have found the discount factor to decline as the length of the time horizon increases. In his study of farmer's time preferences Pender (1996) found that rates of time preference were higher for outcomes delayed by 7 months compared to those involving a 12-month delay. Unlike the exponential discount function of the standard discounted utility theory, a declining discount factor means the relative marginal price of waiting for a later reward declines as the length of the horizon increases. The

typical explanation given for this observed behaviour is that the difference between today and the more immediate future is more vivid and seems to be greater than the difference between today and the remote future. In his discussion of the consumer's planning horizon, Friedman (1963, 10-11) argues that "....a unit may adopt one horizon for determining housing expenditures and another for food expenditures because these types of expenditures involve different time structures of future commitments"

Weitzman (1994) questions the appropriateness of the implications of the assumption of a temporally invariable discount rate, at least when applied to the environment, because this seems to contradict observed trends in the economy. He argues that with growth in per capita income, there is an attendant increase in the importance accorded the environment, as evidenced by increases in expenditures for improving the environment and a general willingness of societies to accept lower rates of return for projects with environmental consequences[2]. Using an aggregate model of the economy and explicitly accounting for expenditures for environmental improvement and the elasticity of response to it, Weitzman shows that "environmentalism" actually implies systematically lower social rates of time preference over time.

Among other factors, the study reported in this chapter examines the distribution of private rates of time preference for a given time horizon, and also investigates whether these rates of time preference change as the time horizon changes. Suppose the amount of consumption at time *T* required to offset the loss of a unit of consumption in the current period increases with *T*, the distribution of marginal rates of substitution should shift to the right (i.e. increase) as *T* changes. Since the marginal rate of substitution varies with time, and is linked to a unique rate of time preference it is possible to test whether the rate of time preference varies with time. The literature cited above suggests that the rate of time preference falls over time. Following Cropper *et al* (1991) a test of the hypothesis that people discount at a non-constant rate can be conducted by assuming that the rate of time preference falls linearly with time:

$$\delta(t) = \gamma - \beta(t), \qquad \gamma, \beta > 0 \tag{4}$$

[2] Several reasons can be suggested for the increasing importance of the environment, 1) high income levels typically result in increased environmental degradation through pollution, habitat destruction, and the like; and 2) environmental amenities represent luxury goods with relatively high income elasticity.

The intercept (γ) of the rate of time preference function is the mean of the rate of time preference, and the gradient (β) measures the responsiveness of the estimated rate of time preference to changes in the time horizon.

Category of Good and the Rate of Time Preference

The possibility of different discount rates for different categories of goods has long been recognised in the literature. But some economists worry that allowing this possibility means that variables such as consumer's net worth (including the discounted value of his future income stream) would not be uniquely defined, rendering such concepts as permanent income meaningless (Landsberger, 1971). However, that different rates of time preference may be used for discounting different goods seems to be supported by the findings in behavioural economics that suggest that individuals divide assets into separate budgets to facilitate actions that require self-control (Thaler,1981).

In experimental studies involving American university students, Loeweinstein (1987) found that an outcome that produces savouring (pleasure) is delayed and the one that produces dread (pain) is speeded up, upon which he concludes that the discount rate depends on the consumption good. Ruderman et al (1987) estimated the discount rates for eight different appliances and found values ranging from 16.1% for air conditioners up to 244.4% for electric water heaters. Differences in discount rates imputed different categories of goods may be a result of some goods possessing special characteristics that encourage heavier discounting.

To test whether the rates of time preference vary depending on the category of the consumption good under consideration, rates of time preference for different goods for a given time horizon may be estimated and a their distributions examined. A regression of the estimated rates of time preference on dummy variables representing the different goods can be employed, for example:

$$\delta = \alpha + \phi \text{ (DUMMY)} \qquad (5)$$

where DUMMY is a dummy variable which indicates say, whether the good is firewood or maize. The intercept (α) of the rate of time preference function is the mean of the rate of time preference, and the slope (ϕ) is the difference between the rates of time preference used to discount the different goods.

Individual Characteristics and the Rate of Time Preference

Since the rate of time preference reflects a person's attitude towards the future, it is reasonable that private rates of time preference vary across individuals depending on the individual's socio-economic characteristics, for example, family size and composition, age, and household income. However, economic theory predicts that when perfect capital markets exists and individuals can borrow and lend freely, the individual will make his or her intertemporal choice such that at the margin the discount rate is equal to the relevant interest rate, and is independent of the individual utility function. The classical hypothesis following from this result is that all individuals have the same discount rate under all situations[3]. However, market imperfections and the absence of markets will lead to varying individual rates of time preferences. A growing body of empirical evidence confirms the hypothesis that a number of external and internal factors may influence an individual's evaluation of consequences that are to occur in the distant future. Private rates of time preference may vary with factors that affect marginal utility (size of income) and the pyschological composition of individuals and his or her characteristics (such as their attitude towards risk, capacity to imagine the future, age, family size and composition etc.) (Jungermann 1988).

Several authors have suggested that individuals believe that there is a positive probability that delayed consumption will not be realised, and that even if the decision problem is stated in terms of certainty conditions, individuals "frame" the decision as involving some risk (Kahneman and Tversky 1979; Loewenstein 1986). Regarding benefits, a risk averse person may have a positive time preference, while a risk prone person may tend towards a negative time preference. Other internal factors (i.e. factors

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[3] This ignores the relevance of transactions costs, which in the real world may be significant and preclude the transfer of resources between the present and the future, and among activities. Moreover, in many developing countries markets may not exist to facilitate such exchanges.

within the person) also influence expectations and the valuation of future outcomes of a decision including the factual knowledge that the individual has concerning the actual probability of consequences. The amount of knowledge about the probable future varies from one person to another, for example, parents, children, experts, the educated and laypeople, and is likely to be source of differences in time preferences among these classes of people.

Deferring consumption into the future requires that the consumer have an ability to anticipate the future and the utility that future consumption will generate. Older people may be at a point in their lives where they pay significant attention to such decisions. If one values the consumption of future generations, as an inheritance value, the marginal utility of personal future consumption could be discounted less. On the other hand, limited and uncertain life spans mean that older consumers might face the risk of not being able to enjoy consumption in the future, even if the promised future consumption will be delivered at the promised date (Basley, 1961). Thus if the consumer values future consumption for their own consumption, the rate of time preference may increase with the age of the individual. Therefore, there may be a negative or positive correlation between age and time preference in such situations.

Some studies have found that individuals with young children have higher discount rates than those without. Such behaviour may be explained by the fact that parents are more concerned with the welfare of their children during their growing years than as adults. In developing countries, such behaviour may be reinforced by an environment characterised by high rates of infant mortality and high incidences of malnutrition which takes a larger toll on the young. A negative correlation may be expected between individual rates of time preference and the number of adults in the respondent's household. A larger number of adult members in the households may create an individual-household trade-off problem that may limit the head of the household's ability to make decisions that adequately account for future consumption needs in individual behaviour.

For poor households, low levels of current consumption may tend to make the demand for current consumption very high, making future consumption seem less important. In such circumstances the marginal utility of a unit of current consumption

will be valued more than the marginal utility of a unit of future consumption (Fisher, 1930). Hausman (1979) examined discount rates implied in households' decision to purchase home air conditioners. Using a model of household energy demand, Hausman develops a utility maximisation model that reflects the trade-off between initial investment (cost) and operating cost (saving stream) to estimate discount rates ranging between 89% for low income households and 5.1% for high income households.

Individuals with more education (as measured by the level of formal education attained) are more likely to have a better appreciation of good things the future may hold and the wisdom of deferred gratification (Pigou 1932), and thus are likely more future-oriented (have lower rates of time preference) than those without any education or with a low level of education.

The influence of individual characteristics on the rate of time preference may be tested using :

$$\delta = \beta X_{ij} + \xi_{ij} \tag{6}$$

where β is the regression coefficient and ξ is an error term, *i* denotes the subject and *j* denotes the type of good.

Eliciting Rates of Time Preference

Discounted cash flow analysis is often used by governments and donor agencies at the social or community level, when they employ techniques such as benefit-cost analysis for choosing between projects in the public domain. The discount rates employed by governments and donor agencies are explicit. For example, the World Bank uses a discount rate of 10% to evaluate public projects in developing countries. On the other hand, individuals apply intuitive discounting procedures to their private decision-making processes, and their discount rates (time preference rates) are implicit. Private rates of time preference are often difficult to identify, and in rural areas in developing countries, the absence of well-functioning markets makes it more difficult to study these discount rates. This study uses survey techniques, based on deferring rewards to try and

quantify private rates of time preference for small-holder farmers in the communal lands in Zimbabwe.

The individual's rate of time preference can be elicited by offering respondents binary choices between a specified amount of a good to be received now and alternative amounts to be received at a later date (for example, Cropper et al 1991; Pender, 1993). This study conducted interviews using questionnaires with the respondent being presented with six binary choices between a fixed amount of a good to be received today and an alternative amount to be received at a given future date.

The questions were asked in a bidding game format in which the respondent was asked to choose between receiving 10 buckets of maize (or headloads of firewood) today and a specified quantity of the good (at least 10 buckets (or headloads)) to be received at a future date. The order in which the questions were asked was such that the size of the future reward in the pair of choices increased in subsequent questions regardless of the respondent's answers to the previous questions (see Table 2-1). It was anticipated that when the size of the future reward is small relative to the early reward, respondents will prefer the early reward over the future reward, and that when the future reward became "large enough" respondents will "switch" from preferring the early reward and choose the future reward. The objective of the discounting experiment was to determine the point at which the respondent "switches" from preference for an early reward to preference for the future reward, from which a range for the respondent's rate of time preference can be inferred.

A *Shona*[4] (the local language) version of the questionnaire was administered during the survey. The following is a sample of the type of questions that interviewees were asked:

[4] The researcher is fluent in Shona (spoken and written).

Q1. Suppose you were one of the people who volunteered to help on a donor agency funded school construction project. The project has just been successfully completed. In appreciation the donor agency is offering you a choice to receive 10 buckets of maize now or you can choose to receive 10 buckets of maize 1 year from now. You can only choose one of the options. We emphasise that these are hypothetical choices and are not being considered as a future project plan by any donor or government agency. Assume you and the donor agency will have a legally binding agreement that ensures that you or any member of your family is guaranteed to receive the maize at the time you choose to collect it. Which would you choose:

A. 10 buckets now or **B**. 10 buckets 1 year from now

Q2. 10 buckets now or 10.5 buckets 1 year from now

Q3. 10 buckets now or 11 buckets 1 year from now

Q4. 10 buckets now or 12 buckets 1 year from now

Q5. 10 buckets now or 14 buckets 1 year from now

Q6. 10 buckets now or 16 buckets 1 year from now

The respondent was asked to indicate which alternative he/ she preferred within each choice pair. Each choice was presented on a separate card, and the respondent's choice was recorded and marked on the card. The cards were presented in the order listed above. At the end of the interview the respondent's choices were displayed before the him/ her, and the respondent was asked whether he wanted to change any or his her responses. This was intended to facilitate full understanding of the experiment and allow subjects to check the consistency of their responses, thus allowing participants to reveal their true preferences.

Since 2 different goods and 3 different time delays (time horizons) were employed in the study, six versions of the questionnaire (six experiments - E1-E6) were used. The questionnaire administered to each respondent was randomly selected. Table 2-1 shows the structure of the six experiments. All choices in the experiments include the option of receiving 10 buckets of maize (10 headloads of firewood) now (the reference date for the early reward is July 1994). The length of the time horizon in experiments E1

and E4 is 1 year, 5years for experiments E2 and E5, and 10 years for experiments E3 and E6.

Table 2-1: Structure of experiments

Experiment	Good	Time horizon (years)	Magnitude of future reward (buckets/ head-loads) *vs* 10 now	Implied rate of time preference (annual compounding) (%)
E1	Maize	1	10	0
			10.5	5
			11	10
			12	20
			14	40
			16	60
E2	Maize	5	10	0
			13	5
			16	10
			25	20
			54	40
			105	60
E3	Maize	10	10	0
			16	5
			26	10
			62	20
			289	40
			1100	60
E4	Firewood	1	10	0
			10.5	5
			11	10
			12	20
			14	40
			16	60
E5	Firewood	5	10	0
			13	5
			16	10
			25	20
			54	40
			105	60
E6	Firewood	10	10	0
			16	5
			26	10
			62	20
			289	40
			1100	60

The questions were designed to reflect local conditions, using local commodities and local measures. Maize is ground into flour that is used to make *sadza,* the staple for Zimbabwe, while firewood is the main source of energy for cooking, heat and lighting in the rural areas. The commonly used measure for maize is a bucket, and this generally refers to a 20 litre container (empty oil and petroleum lubricant containers are common for measuring quantities of grain). In the rural areas in Zimbabwe firewood is collected from the communal woodlands, usually by women, who carry it to the homestead on their

heads, sometimes over long distances. As a result the general measure for quantities of firewood is a headload (approximately 15 - 20 kg).

Experimental Study of Rates of Time Preference

Study Area and Data Collection

The case study was conducted in Chimanimani district, in eastern Zimbabwe (Appendix A). The sample area covers Natural Region V[5] (the low-lying part of the district), an extensive farming region receiving low rainfall and with poor soils. The annual average rainfall in the area is about 527 mm, barely sufficient to support rain-fed cultivation of drought tolerant crops such as sorghum and millets (Campbell et al, 1994). The household surveys were conducted in six villages - Chibuwe, Jinga, Munanzi, Nechitima, Nemaramba, and Nemutenzi. The villages are spatially contiguous and have roughly the same ecological conditions. The soils are shallow loamy sands and sandy loams derived from granite parent material. The farmers in this area keep cattle and goats, which are grazed in the indigenous woodlands and the arable areas during the dry season. The vegetation in the area is predominantly mopane woodland (*Colophosperum mopane* with *Commiphora* and *Acacia* spp). Baobab (*Adansonia digitata*), which is generally found in mopane woodlands, is also widespread. Generally the farms are small, averaging 2 hectares per household, and the respondents are subsistence farmers. A socio-economic profile of the respondents is presented in Table 2-2. This summary demonstrates great variation in socio-economic circumstances among the households included in the study.

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[5] Zimbabwe is divided into 5 agro-climatic regions based on rainfall and agricultural potential (see Appendix A).

Table 2-2: Socio-economic profile of respondents

Criterion	Average (standard deviation)
Age of respondent (years)	39.5 (15.1)
Number of adults per household	3.9 (2.8)
Number of children per household	3.4 (2.7)
Level of education of respondent (years)	7.4 (2.3)
Number of cattle per household	1.7 (2.8)
Number of goats per household	5.8 (8.2)

Twelve research assistants (2 from each village) helped conduct the interviews. Employing local people to administer the surveys helped create trust and confidence among the respondents during the period of the research and facilitate the revelation of respondents true time preferences. Prior to conducting the surveys, the research assistants received some training in interview techniques. A pre-test of the questionnaire in a village, separate from the actual survey site, provided an opportunity for the research assistants to practise their interviewing skills before participating in the real survey. Both the training and the interviews were conducted in Shona, the local language, in which the researcher is fluent.

To facilitate the revelation of true preferences, the hypothetical cases were constructed around a scenario familiar to the people, using goods that are part of everyday use to most people in rural Zimbabwe – maize and firewood. Furthermore, some props were used in the form of pictorial representation of the quantities involved in the questions.

The questionnaire was administered to the head of the household (or any member of the household 18 years of older). A total of 445 households participated in the study which was carried out in July 1994. The sample households were identified from village lists (list of all households in the village – there were approximately 700 households in total, in the six villages) created by the research assistants, prior to the actual survey. Of the 445 households that were interviewed, 58 (13%) either "switched" more than once or had missing data, and thus were not included in the analysis. Of the remaining 387 observations, approximately 72% were female.

Calculating Rates of Time Preference

The private rate of time preference is calculated following equation 3 as

$$\delta = \left(\frac{C_t}{C_0}\right)^{\frac{1}{t}} - 1 \qquad (7)$$

where C_t is the amount of consumption in time period t and C_0 is the amount of consumption in the current period, where the individual is indifferent between the receipt C_0 to be received now and a receipt of C_t to be received at a later date *t*.

In the experiment, if the respondent "switched" from preference for the early reward to preference for the delayed receipt, a range for the rate of time preference could be inferred. For example, if the respondent preferred the early receipt in the first four choices in E1 and the delayed receipt in the last two choices his rate of substitution between present and future reward would be between 1.2 and 1.4, implying a rate of time preference between 20% and 40%. If the respondent preferred the future reward in all choices, the implied rate of time preference was inferred to range between a negative value and zero (0). But since the possibility of negative rates of time preference was not factored into the experimental design only the upper bound (0%) of the respondent rate of time preference can be inferred in this case. On the other hand if the respondent preferred the early reward in all choices, the implied discount rate from his/ her choices was inferred to vary between 60% and some larger positive number. Since the experiments did not contain contingent trade-offs in which the implied discount rate was larger than 60%,in this case only the lower bound (60%) of the individual's rate preference could be inferred from such choices. Of the total sample, 41 respondents (9% of the sample) "switched" more than once. This involved switching - from preference for an early reward to preference for a future reward, and then back to preference for an early reward, or switching from a preference for a future reward to preferring an early reward and then back to preference for a future reward. In these cases nothing could be inferred about the respondent's rate of time preference.

There are some possible explanations for some of these patterns of behaviour. For example, a case where a respondent changes from a preference for an early reward to preferring a future reward and then "switches" back to preference for an early reward (or a switch from preference for future reward to a preference for an early reward) may occur when the promised future reward is very large, which may result in an increase in the perceived risk that the reward will not be delivered at the promised time. Alternatively, some of the multiple switches could be a result of respondents not fully understanding the question.

Experimental Results: Summary of the Raw Data

To summarise the raw data from the experiments, arithmetic means and medians of the rate of time preference are presented in Table 2-3. The mean of the rate of time preference was calculated as an average of the lower and upper thresholds of the individual's rate of time preference. In the case where it was only possible to infer the upper threshold (0%) or the lower threshold (60%) these values were taken as the means. The results show that the means (medians) of the rates of time preference are very high (RTPs are measured in real terms) compared to the real bank lending rate which stood at about 5 % in 1994 (the nominal rate was 35% while the rate of inflation was about 30%); and are much higher that the 10% real discount rate generally used by the World Bank and other non-governmental organisations to evaluate public and community projects. These findings are consistent with estimates from other developing countries (Pender, 1991; Street, 1990; Zuhair, 1986). The very large implicit discount rates may to some extent be a reflection of the hypothetical nature of the questions and the nature of the goods used in the experiments - they are basic necessities for the households.

The means and medians of the rates of time preference are generally higher for future use of firewood than for future consumption of maize. Contrary to the findings of other experimental studies in which discount rates have been found to decline with increases in the time horizon, the results suggest that the of rate of time preference may increase with the time horizon, at least for the categories of commodities considered here. For maize, the mean of the rate of time preference for the 10-year horizon is significantly

higher (at the 5% level) than that for the 5- and 1-year horizon, and its also significantly higher (at the 5% level) for the 5-year horizon than it is for the 1-year horizon. The pattern is the same for firewood, except for the 1-year horizon in which the mean of the rate of time preference is significantly higher than that for the 5-year horizon. These findings are tested econometrically below.

Table 2-3: Structure and responses to the experiments

Experiment	Good	Length of horizon (years)	Mean (Median) rate of time Preference (%)
E1	Maize	1	24.1 (5 - 10)
E2	Maize	5	25.8 (5 - 10)
E3	Maize	10	38.8 (≥ 60)
E4	Firewood	1	36.6 (≥ 60)
E5	Firewood	5	30.1 (10 - 20)
E6	Firewood	10	36.7 (≥ 60)

There was considerable variation in measured rates of time preference among the individuals, perhaps reflecting the absence of markets for the commodities. About 45% of the respondents always preferred the early reward, or were unwilling to trade-off current consumption for future consumption (at least not at the marginal rate of substitution implied by the choices presented to them). It is possible that if the size of the promised future reward used in the study was increased further more respondents would be induced to choose delaying consumption. However, increasing the amount of the future reward further would have likely resulted in figures too large (especially in experimentsE3 and E6) to be easily comprehensible or believable by respondents. Fewer respondents (20%) always preferred the future reward. Maybe these respondents already have more maize or firewood than they could use and had reached their satiation threshold.

Econometric Analysis of the Results

Maximum likelihood estimation was used to analyse the data, assuming a normally distributed error term. Suppose the rate of time preference of individual *i* for good *j* is determined by:

$$\delta_{ij} = X_{ij}\,\beta + \varepsilon_j, \quad \varepsilon_{ij} \text{ i.i.d. normal } (0, \sigma^2) \tag{8}$$

where X_{ij} is a vector of characteristics of individual *i* with a dummy variable (0,1) with a value 1 for good *j*, and β and σ are to be estimated. We observe X_{ij}, and δ_{ij} is the computed average rate of time preference used to discount future consumption of good *j* by individual *i*. Presenting individuals with a series of binary choices between a specified amount of a good to be received now and alternative amounts to be received at a later date allows us to determine an interval range for his/ her rate of time preference, from which the average rate of time preference, δ_{ij}, can be calculated.

In the study, 20% of the sample always choose the future reward. It was assumed that respondents who always choose the future reward possess a zero (0) rate of time preference. Thus potential negative values of the individual rate of time preference (which were not explicitly accounted for in the experimental design) are transformed to a value of 0. Another 45% of the sample always chose the early reward. In this case the rate of time preference implied in the sixth and final pair of choices (60%) was assumed to be the lower bound of the individual's rate of time preference, and was also used as an estimate of the individual's average rate of time preferences. For the econometric analysis it is assumed that the calculated individual average rate of time preference is a continuous variable whose distribution is censored in both the lower and upper tails (values of the dependent variable are limited from below as well as from above). Since the experimental design was to allow the determination of an interval for the individual rate of time preference, it would be more accurate to depict the rate of time preference as a categorical variable. Although treating the average rate of time preference as a continuous variable may introduce some bias in statistical estimates of the rate of time preference, the resultant variable can be analysed using simple regression techniques with

the added advantage of being able to estimate an average rate of time preference for the sample using parameters of the model.

In choosing econometric techniques for estimating the model, the restriction on the observable range of the dependent variable cannot not be ignored given the sizeable proportion of the respondents whose estimated rate of time preference take limit values. Conventional regression methods fail to account for the difference in the level of information contained in limit/ threshold observations and continuous or non-threshold observations (Greene, 1990), because they assume the variable of interest can take any value between - ∞ and + ∞. Parameter estimates obtained from applying least squares regression to a censored variable will be biased and inconsistent. When the dependent variable is censored, consistent parameter estimates can be obtained by use of a censored regression model or the Tobit model following (Tobin, 1958). The structure of the model is as follows:

$$\begin{aligned}
&y_i^* = \beta' X_i + \varepsilon_i && \varepsilon \sim N[0, \sigma^2] \\
&y_i = L, \quad \text{if } y_i^* \leq L && \text{(lower tail censoring)} \\
&y_i = U, \quad \text{if } y_i^* \geq U && \text{(upper tail censoring)} \\
&y_i = y_i^*, \quad \text{if } L < y_i^* < U &&
\end{aligned} \tag{9}$$

where y_i^* is an index or latent variable and y_i is the observed/ actual value of the dependent variable. If the respondent did not switch, y_i^* is not observed and is recorded as L or U. The Tobit model can be efficiently estimated using maximum likelihood techniques (since the values of L and U and the variables that determine y_i^* are known). Following Greene (1990), the log-likelihood function for the doubly censored regression is given by:

$$\begin{aligned}
\ln L = &\sum_L \ln \Pr ob(y^* \leq L) + \sum_U \ln \Pr ob(y^* \geq U) + \\
&\sum_i [-\frac{1}{2}\ln(2\pi) - \frac{1}{2}\ln \sigma^2] - \frac{1}{2\sigma^2}(y_i - \beta' x_i)^2
\end{aligned} \tag{10}$$

The log-likelihood function has three parts, the first part is the probability of an observation being a lower limit (L) value (measured by the cumulative distribution function (cdf) of a standard normal) summed over all observations in this category, and

the second part is the probability of an observation being an upper limit (U) value summed over all observations in this category. The third part is the sum over all nonlimit/ the middle set of observations.

The general model (equation 8) was estimated using the Tobit model and was used for three separate analyses: (1) analysis of the difference between rates of preference used to discount different types of goods, (2) analysis of the "length of the time horizon", and (3) analysis of the variation in rates of time preference across respondents as a function of individual and household characteristics. To test for 'good effects' (GEFF) the following version of the model was estimated:

$$\delta_{ij} = \alpha + \phi\,(\mathrm{GEFF}) + \varepsilon_{ij} \qquad (11)$$

where GEFF = 1 for firewood and 0 for maize. The results are contained in table 4. The rate of time preference used to discount firewood is significantly different (at the 5% level) from that used to discount maize. This is inconsistent with the practice of organisations such as the World Bank and other non-governmental organisations, and many governments that use the same discount rate to discount irrigation and forestry projects. The mean of the rate of time preference is 38.2% for maize and 55% for firewood. The means of the rates of time preference are substantially higher than the 10% discount rate used by the World Bank to evaluate projects. However, such high discount rates may not be very surprising given that the goods considered here are very basic to the survival of people in rural Zimbabwe, and that many households live at the edge of subsistence. Maize is the staple food of Zimbabwe, while firewood is the major source of energy, supplying nearly all of the energy needs of rural households. Since maize is harvested annually, the greatest need for maize is usually before the next harvest. This could be one of the reasons for preference for immediate receipt of maize over later receipts. Firewood is gathered mostly from commons where claim to the resource follows the rule of capture. If respondents believe that most of the firewood would have been harvested by others, or that only inferior quality material will remain at the future date, it is reasonable to expect the respondents to prefer early receipts over delayed receipts.

Table 2-4: Tobit estimates of the rate time preference function: $\delta = \alpha + \phi$ (GEFF)

Variable	Coefficient (t-statistic)[a]
μ_α	0.382
	(6.87)*
ϕ	0.168
	(2.14)*
σ_α	0.687
	(13.44)*
Log(L)[b]	-347.51
Sample size (N)	387

[*] significant at 5% level

[b] log(L) is the value of the log-likelihood function at the maximum

To test if rates of time preference vary with the length of the time horizon the model in equation 4 is estimated and the results are contained in Table 2-5. With the raw data (Table 2-3) suggesting an increase in the means and medians of the rate of time preference with time, especially the rates applied to maize, the sign on the parameter β is hypothesised to be positive. The model is estimated using the pooled and also separately for maize and for firewood observations. In the pooled model the rate of time preference increases with the length of the time horizon, and time is also significant for the maize sub-sample. This result suggests that respondents have a non-exponential discount function. The effect of the length of the time horizon is opposite to the results obtained by Cropper *et al* (1991) in the context of discounting human lives saved at future dates. An increase in the rate of time preference with the length of the horizon means that the price for waiting for the reward increases as the time required to wait increases. The length of the horizon is not significant for firewood, suggesting the use of a constant discount rate for discounting firewood.

For maize, the mean rate of time preference is 11.9 % in year 0, 17.3 % for year 1, 38.9 % in year 5, and 65.9 % in year 10. The mean rate of time preference used to discount future use of firewood is 51.7 % for year 0, 51.8 % in year 1, 52.1% in year 5, and 52.5 % in year 10. The discount rates differ in magnitude in each case, confirming the results in Table 2-4, that different categories of goods are discounted at different rates of discount.

Table 2-5: Tobit estimates of the rate of time preference function $\delta_i(t) = \gamma - \beta(t)$

Variable	Pooled Data	Maize Grain	Firewood
μ_γ	0.323	0.119	0.517
	(4.70)*	(1.148)	(5.58)*
β	0.027	0.054	0.001
	(2.48)*	(3.13)*	(0.06)
σ_γ	0.684	0.744	0.616
	(13.44)*	(8.98)*	(10.05)*
Log(L)[a]	-346.71	-177.30	-164.0225
N	387	195	192

|t-statistics| appear in parentheses
[*] significant at 5% level
[a] log(L) is the value of the log-likelihood function at the maximum
N is the sample size

Equation 8 is also the basis of the econometric model used to examine the influence of respondent characteristics on rates of time preference, where X_{ij} includes the respondent's sex, age, and household wealth, presence of children (younger than 18 years), and the number of adults in the household. The mean of the rate of time preference varies with respondent characteristics (Table 2-6). The rate of time preference is higher for older respondents than for younger ones, and lower for female respondents than for males. These results are also consistent with the findings of other studies that have shown that individuals have different preferences with respect to intertemporal allocation of consumption.

Table 2-6: Tobit dstimates of the determinants of the rate of time preference

Independent variable	Coefficient (t-statistic)
λ	0.033
	(0.17)
Sex (female = 1)	-0.115
	(1.31)
Age (years)	0.007
	(2.64)**
Cattle (number of)	0.014
	(1.00)
Children ≤ 18 at home	0.035
	(0.28)
Adults (number of)	0.002
	(0.13)
Length of time horizon (years)	0.027
	(2.48)**
Good (firewood = 1)	0.143
	(1.85)*
σ_λ	0.669
	(13.47)**
log(L)[b]	-339.25
Sample size	387

** significant at the 5% level, * significant at the 10% level,
[b] log(L) is the value of the log-likelihood function at the maximum

Discussion

This study shows how survey data can be used to study rates of time preference implicit in individual's intertemporal decisions. Survey techniques can be used to reveal people's preferences for different amounts of a commodity offered hypothetically at different times. The use of hypothetical questions has many critics, but when carefully used such techniques provide the opportunity for controlling the influence of confounding variables when trying to understand the relationship between selected economic variables. Few experiments using real exchanges have been designed in order to deal with this problem, but the absence of good natural experiments has caused limited progress on this front. Economic data obtained from actual behaviour in markets have the attraction of reflecting real behaviour, but lack a controlled testing environment, means that such data contains a lot of "noise". Identification, measurement and statistically controlling for confounding variables is required for the analysis of market data in order

to study only the relationships of interests. Such requirements are not always easy to attain.

Economic theory was applied to the survey data to observe an average rate of time preference of 40.7 % per year for the future consumption of maize and 52.1 % for the future use of firewood. Since the same methods were used to elicit time preferences for maize and firewood offered at different points in time, and the subjects were located in the same environment, the differences in the observed rates of time preference confirm the suggestion that rates of time preference may vary for different categories of goods.

The findings of the study show a systematic increase in the rate of time preference, particularly for the future use of maize. This finding is contrary to other studies that have observed a decline in the discount rate with the time horizon. These studies use hypothetical money amounts and lives saved (Thaler, 1981; Cropper et al 1994), and economic data on future health (Kashner, 1990) in their instruments to reveal respondent's preferences for different amounts of the "good" offered at different times. The nature of the commodities used in the present study in relation to the economy in which the study was conducted may be one reason for the contrasting result. Maize and firewood are basic necessities needed for everyday survival for rural households in Zimbabwe. In hostile circumstances (frequent droughts and food shortages) any delayed consumption is just too far off, and in any case present survival is a precondition for acquisition of future utilities. The finding of this and other studies that people's rates of time preference change with the length of the horizon represents a departure from the standard economic model's which predicts constant rates of time preferences. These results derived under assumptions of rational behaviour do not lend support for the well-received practice of exponential discounting.

The mean of the rate of time preference is lower for women and higher for older respondents. Although only summary statistics for rates of time preferences are presented in the tables above, there is great variability among households. Because individuals are likely to have different levels of risk tolerance and different levels of resource endowments, it follows that they would have different preferences with respect to intertemporal allocation of consumption. Well functioning goods markets can serve to

moderate private rates of time preference and to adjust individual behaviour in line with market interest rates.

The estimated rates of time preference are very high, again probably reflecting the fact that the goods are necessities for the households, and partly reflecting a high degree of risk aversion among respondents. However, these rates are lower than the estimates obtained by researchers in other developing countries using similar techniques. For example, Pender's (1991) estimates of discount rates for Indian farmers ranged from -18 % to 119 % per year and a median of over 50 %. For Haitian tree planters, Street (1990) estimated a mean rate of time preference of 234.4% (median 75%). A search of the literature revealed no studies based on market data with which to compare the imputed discount rates found in this study.

Conclusion and Implications of the Results

This study concludes that there exists a difference between individual's intertemporal preferences for different goods. In particular, rates of time preferences used to evaluate future use of firewood are significantly higher than those used to evaluate future consumption of maize grain. There are several possible explanations for this finding: 1) respondents may anticipate firewood to be scarce in the future, resulting in an increase in its relative prices, while maize is expected to be available without the same serious limitations, 2) since firewood is collected from an open-access regime, high rates of extraction are expected to make firewood scarcer in the future than maize grain, a private good, 3) existence of an individual satiation threshold which limits the amount of current consumption, 4) existence of cultural restraints that limit the level of individual accumulation (for example, gifting without expectation for reciprocity and the sharing of goods may be some of the ways in which such restraints are manifested), and 5) the limited storage time for maize may limit the amount that can be accumulated by the individual (in the rural areas maize stores well for about a year).

The findings of this study confirm other results that have shown that people do not discount at a constant exponential rate. However, contrary to other studies that have found the discount rate to decline with an increase in the length of the horizon, this study

found the discount rate to increase with the length of the horizon. One possible explanation of this result is that since the commodities considered in the study are necessities for households and have few or no substitutes, the need for survival today exerts a very strong pull such that consumption in the distant future cannot compete with present consumption. That the discount rate for the future use of maize increases markedly with the length of the time horizon, may also be due to the fact that maize can be stored on farm reasonably well for one year (after one year storage losses become exceedingly high), after which availability of maize is anticipated to be very limited. Although the rate at which future use of firewood is discounted over time does not show the same marked increase it is consistently very high.

The implicit rates of pure time preference estimated in this study are quite high, and they are variable across individuals, reflecting lack of well-functioning markets for these goods. Despite the attempt to formulate the decision under certainty conditions, the respondents may not believe that the future reward would be available at the designated time. Also the fact that the goods are necessities (survival today is important for today itself and as well as for the future), it is likely that these goods would be discounted at higher rates than other goods.

If these results are indicative of the discount rates used by farm households in the rural areas, high rates of time preference in rural households may be a major factor contributing to environmental degradation in Zimbabwe. When people discount the future heavily, they will not take steps to protect the future environment, and neither will they care about the future productivity of resources. The important implication of the findings is that if the pervasive idea that high discount rates in poor countries contribute to environmental degradation, policy makers should look for ways to alter the behaviour of households. Several options for eliciting the desired behavioural changes may be considered, including the establishment of credit markets and insurance schemes, and providing rural households opportunities to diversify risk in their production activities. If people have access to credit markets they will be induced to change their behaviour in ways that will be compatible with relevant market-determined interest rates. Moreover, credit and insurance markets will allow them to smooth their consumption over time,

without having to rely heavily on resources during times of low production. The ability to diversify risks will also result in less pressure on resources.

The observed rates of time preference vary with individual and economic characteristics, being lower for female than for male respondents, and higher for older than for young respondents. Households with young children (< 18 years) and household with a larger number of adult members tend to have higher rates of time preference, and also rates of time preference seem to be higher for poor than for richer households (although statistical tests do not show these influences to be significant). Such findings of widely varying rates of time preferences exhibited by individuals can be of great importance in better understanding and predicting behaviour, such as adoption of technology and tree investments decisions, and designing more effective policies.

A word of caution would be fitting at this point. Several limitations might have affected the accuracy of the results. Firstly, long-term trade-offs involving time horizons of 1 year, 5 years and 10 years, may be beyond what households are familiar with, thus could be a source of systematic errors in respondent's comparisons of his opportunity costs and the present value of the of amount future consumption being offered. It would be worthwhile to conduct similar studies but this time using shorter time horizons, for example, 3 months or 6 months, to see if there would be any differences in imputed rates of time preference. That the results are derived from responses to hypothetical questions may impose constraints on the extent to which the results can be generalised, as there is evidence of the strong dependence of responses to wording and format of the survey instrument. It should also be noted that although the present study attempted to measure pure rates of time preference, it is still likely that the estimated rates of time preference reflect to some degree the risk perceptions of households. The respondents may not fully believe that promised future consumption will be delivered at the promised date, particularly when dealing with long time horizons such as are considered in this study.

Future research would be able to provide guidance to policy if estimated rates of time preference are linked to a specific economic problem, for example, household tree planting decisions. Furthermore, simple simulations could be carried out to investigate the effect of changes in socio-economic variable (e.g., level of education) on the rate of time preference and the change on tree investments by household.

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CHAPTER 3

Risk and Insurance in a Household Economy: The Role of Cattle as a Buffer Stock

Introduction

The vast majority of rural households in developing countries face substantial income risks. A large portion of the risk is a consequence of relying on rain-fed agriculture in environments that are prone to droughts. In addition, the risk of people contracting diseases is very high due to poor sanitary conditions, coupled with a general unavailability of health facilities. Since production processes in these economies are labour intensive, ill health can adversely affect the household's production and consumption possibilities. Other sources of risk faced by households include incidence of livestock and crop diseases, and the variability of agricultural prices.

The dearth of formal insurance and credit markets in rural areas in developing countries is a legitimate cause for concern as to the ability of households to fully insure themselves from adverse income fluctuations, and to protect their consumption. However, a large body of literature suggests that households in low-income countries use a wide variety of mechanisms, often informal, to at least partially limit consumption fluctuations (Platteau 1991; Townsend 1995). Rosenzweig (1988) has found that some rural Indian households may marry daughters deliberately out over space, so that remittances can flow between areas depending on who is suffering a negative income shock; Grimard (1992) has found that ethnic ties allow consumption smoothing to among households in Cote de'Ivoire.

Households may also employ a variety of mechanisms to self-insure against income fluctuations. It has been shown that households adopt land fragmentation and activity diversification as a way to reduce income risk by avoiding having all one's eggs in one basket (Walker and Ryan, 1990; Fafchamps, 1992). Also, households may accumulate assets in good times and sell them in bad times in a bid to maintain their consumption level. The ability of households are able to mitigate the adverse effects of income risk, and the specific strategies employed by different households, are important

pieces of information required to guide the design of policies in the area of consumption smoothing.

As already alluded to in the preceding paragraphs, risk mitigation takes place in two stages: income smoothing/ risk management and consumption smoothing/ risk coping (Morduch, 1995; Alderman and Paxson 1994). If a household anticipates being unable to borrow in the future when it experiences an adverse shock to its income, it may choose its present behaviour with a view to minimise its exposure to risk. For example, the household may choose to plant traditional crop varieties (low but stable yields) instead of high yielding varieties (whose yield is highly dependent on the quality of the growing season). In way the household reduces variability in income and fluctuations in its consumption. Income smoothing may take several other forms, for example, diversification of crops, fields, and occupations, and strategic migration of some family members. The optimal amount of diversification will depend on the household's attitudes towards risk, costs of diversification (in terms of reduced average income), available technologies and the household's ability to smooth consumption when uncertainties are resolved (Alderman and Paxson, 1994).

When a household experiences a shock to its income, it may employ various mechanisms to insulate its consumption. Such mechanisms include: depleting assets, borrowing or demanding debt repayment from borrowers (intertemporal consumption smoothing), making insurance claims, requesting transfers and remittances from friends and neighbours, and sharing meals with other households (risk-sharing) (Rosenzweig and Wolpin 1993; Morduch 1995; Townsend 1995; Besley 1995; Fafchamps et al 1998).

The focus of this chapter is on intertemporal consumption smoothing, in particular the use of household saving and dissaving behaviour to mitigate income risk[1]. It has long been hypothesised that agricultural households in poor countries use livestock as buffer stock to insulate their consumption from income risk (e.g. Binswanger et al 1987;

[1] In reality households are likely to combine a number of strategies in coming up with a general risk-mitigation strategy. When a number of strategies are used in combination, changes in the costs and benefits of one strategy will affect how other strategies are used, and these interactions are important for policy design (Alderman and Paxson, 1994). Although risk mitigation studies that simultaneously consider all the strategies available to households are more desirable and provide a better understanding of household decision-making, data limitations and a high degree of complexity involved often prohibit such undertakings.

Bromley and Chavas 1989). Recently data gathered from household surveys have made it possible to empirically test the validity of this hypothesis (e.g. Rosenzweig and Wolpin 1993, Fafchamps et al 1998). However, only a few of these studies have been conducted in sub-Saharan Africa, where a large majority of the population reside in rural areas and derive their livelihood from agriculture, and the pervasive lack of contingency markets and income-support programs means households have to rely largely on indigenous self-insurance mechanisms. More studies are needed to improve our understanding of the risk-mitigation strategies employed by different households. Such knowledge should help to inform public action, as it enables a better assessment of the extent to which real gaps in the market system are effectively filled by local individual and institutional responses.

This knowledge may also lend some insights into longer-term development issues. Some particular strategies employed by households to mitigate risk may impede economic growth and development. For example, wealth may be stored in assets that yield low returns, since risk-market failures discourage productive but risky investment (Eswaran and Kotal, 1989). Where livestock are the only readily accessible vehicle for wealth accumulation, there may be an over-accumulation of livestock, with the attendant environmental degradation problems. Also, the extent and effectiveness of public intervention aimed at alleviating distress during periods of low income will depend on the knowledge about how well individuals can provide for bad times.

The study investigates the use of cattle transactions for consumption smoothing using a household-level panel data set from two communal areas in Zimbabwe, spanning the period 1992-1996. The study period encompasses the drought years of 1992 (the worst drought that Zimbabwe has experienced in recent times) and 1995. The data are appropriate for testing the buffer stock hypothesis because they (a) cover a number of years (five-year panel), which better reflects the dynamic nature of the process being studied (asset accumulation is an inherently dynamic issue); and (b) large aggregate shocks occur during the study period, a factor likely to trigger asset transactions.

In 1992 and 1995 Zimbabwe experienced severe nationwide food shortages, particularly maize grain (Zimbabwe's staple). Although the country could afford to import enough food to meet domestic demand, issues concerning the targeting of food aid to limit public assistance only to those unable to purchase food from the market, and how

to help others mobilise their resources to enable them to purchase food emerged. For example, criteria such as a minimum of two head of cattle (the minimum for drought power supply), and having no member of the household engaged in off-farm employment at the time, were used by officials to determine who qualifies for food aid or for work in government-run income-support projects. The Cold Storage Commission (a state owned meat packing company) and commercial farmers, whose better managed pastures tend to suffer less from rainfall shortages, were urged to buy cattle from communal farmers.

An event such as a drought tends to affect all members of a community in the same way (an aggregate shock), unlike ill-health which may affect an individual household, negatively impacting its income and consumption (idiosyncratic shock). Intra-village risk sharing arrangements are largely ineffective against aggregate shocks. Households may need to rely on inter-regional resource flows or the depletion of assets in order to protect consumption against aggregate income shocks. Given this background, it is possible to formulate testable hypotheses about livestock accumulation and de-accumulation behaviour of households. Specifically, if livestock have an insurance role, then do livestock sales increase when the household experiences adverse shocks to its income such as during periods of less than normal rainfall[2]?

In the sections that follow, the existing literature and some conceptual issues surrounding the use and accumulation of livestock in rural agriculture-dependent communities are reviewed, and an analytical model is presented that may be used to analyse farmers' asset accumulation decisions in the presence of income risk. The analytical model underpins the empirical model used to test the buffer-stock role of cattle among communal households in Zimbabwe.

Cattle and the Household Economy in Subsistence in Economies

The early literature focused on the cultural aspects of cattle in traditional economies. It has often been asserted that peasant households keep livestock for prestige, and for cultural and ceremonial purposes. However, a closer look reveals the significant financial value of livestock in agro-pastoral economies, as well as a their role as a

[2] Fafchamps *et al* (1998) follow a similar approach in their study of Burkinabe households.

productive asset, and as a source of a number of other outputs (Scoones, 1990). For example, cattle played a major role in local and regional trade in traditional southern African economies for hundreds of years before the advent of colonialism (Beach, 1991). Cattle were exchanged for salt and jewellery, and used in the purchase of durable goods. Indeed, livestock continue to play an important role in local cultural practices. For example, cattle are the preferred means for paying bride price.

The modern economic literature on subsistence economies has focused on the economic role of livestock in agro-pastoral economies (Binswanger and McIntire, 1987; Rosenzweig and Wolpin, 1993; Fafchamps *et al*, 1998). In Zimbabwe and other Southern African countries, cattle are an important capital input in crop production. In a study of communal areas in Zimbabwe, Cousins (1990) reports that almost all households plough with draught animals (whether owned or borrowed). Households that do not own draught animals are severely constrained by lack of draught power that limits the size of the area cultivated and the timeliness with which agricultural operations are carried out. This is important in an environment where delays in carrying out farm operations may lead to severe reductions in crop output[3] (Shumba, 1984; Govereh and Mudimu,1991). Livestock are also valued for their milk and soil manure production (Barrret, 1992, Scoones, 1990).

The importance of livestock in the household economy is reinforced by the fact that livestock can effectively utilise crop by-products as dry fodder. Furthermore, family labour, especially female and child labour that otherwise have little opportunity to be employed off-farm, can have stable employment all year in livestock rearing. Another economic role of livestock, and the focus of the present study, stems from the fact that livestock are a liquid form of assets that can be depleted in a bad year and therefore function as a form of insurance (Swinton 1988; Rosenzweig and Wolpin 1993; Fafchamps *et al*, 1998). Livestock liquidation has been shown to be an important mechanism for smoothing consumption in times when the household experiences adverse shocks to its income. In a study of Indian households Rosenzweig and Wolpin (1993)

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[3] Most communal areas are located in the drier parts of the country. Tillage of the agricultural fields must take place in the generally short period of time between the onset of the summer rains (required to render the soil tillable after the long dry season during which the soil becomes hardened and dry) and the optimal sowing date. Reliance on the rains for agricultural operations causes covariance in the timing of the demand for draft animals and makes it difficult for those households who do not own draft animals to rent draft animals.

found that bullocks were sold to purchase grain in times of less than normal rainfall. In a study using data from Burkina Faso, Fafchamps *et al* (1998) found that livestock transactions play less of a consumption smoothing role than is commonly assumed. Livestock sales are estimated to compensate only 20 - 30 % of income shortfalls due to village-level (aggregate) shocks.

A Model of Asset Accumulation and Asset Buffering Behaviour

Economic theory predicts that rational individuals will endeavour to allocate their resources between all alternative uses, present and future, in such a way that they will have in each the same marginal utility (with future utility discounted at the rate of time preference). Such behaviour would entail among other things, making contingency plans in anticipation of unforeseen income shocks and fluctuations in consumption. In a village economy, the demand for consumption insurance may be met through formal credit and insurance arrangements, or through some private and social mechanisms. A household's intertemporal consumption plan in the presence of future income risk can be viewed as being geared towards the maximisation of its discounted additively separable expected lifetime utility:

$$E_0 \sum_{t=0}^{T} \left(\frac{1}{1+\delta^i} \right)^t U^i(c_t^i) \tag{1}$$

where E_0 is an expectation operator conditional on information available at time period 0, δ^i is the rate of time preference for household *i*, c^i_t is a vector of goods consumed by household *i* in time period *t*. Each household is assumed to live for a finite time horizon, *T*, the maximum possible length of life. Furthermore, households are assumed to be risk averse, thus the utility function satisfies the usual assumptions, $U' > 0$ and $U'' < 0$ (Viscusi and Moore 1989), and is also assumed to be of the decreasing absolute risk aversion (DARA) form. For households with very low levels of income (as is the case with most communal area households in Zimbabwe), risk poses a serious threat to consumption levels, exerting a potentially large influence on the way income is saved and

spent. Households facing greater uncertainty about future income are likely to save more out of current income in order to insure their consumption (Friedman 1957).

For most communal area households, crop sales are the major source of income (y) (Jackson and Collier 1988). The household's income is subject to the realised state of nature, $y(s_t)$, where s_t represents the state of nature at time t, and consists of all aggregate and idiosyncratic income shocks that may affect the households in the village. Utility theory, which underpins the model outlined in this section, assumes that the decision maker (household) has full knowledge of the probability distribution associated with income (y). Fafchamps *et al* (1998) argue that the slow rate of technical change in traditional agriculture, and the fact that the probability distribution of rainfall is nearly stationary render the probability distribution of crop income to be approximately stationary. Thus, it can be assumed that the probability of each state is constant over time and known by all households.

An important shock to communal lands households' income is rainfall variation, which in general, affects all households within the same village in the same way (an aggregate shock). There is a general lack of formal crop insurance in most rural areas of developing countries, and in the case of the two communal areas to which the model developed here will be applied, there is no available evidence to suggest the existence of informal insurance arrangements. Formal consumption credit is also generally unavailable in the communal areas. Although local business people and other wealthy villagers may sometimes provide credit enabling households to deal consumption shortfalls owing to exogenous income shocks, such informal credit arrangements tend to be limited in their geographical scope, and are usually restricted along kinship lines due to the high enforcement costs and moral hazard problems associated with such arrangements (Binswanger and MacIntire, 1987). In any case, these intra-village risk sharing arrangements are largely ineffective against severe and highly correlated income shocks (Platteau, 1991; Udry, 1994).

It is, however, possible that households may rely on ethnic and kinship links to spatially diversify themselves against income risks. The data available for this study does not permit a test of the role of this mechanism in reducing consumption fluctuations. Evidence from other studies have rejected the hypothesis of complete insurance through

ethnic ties (e.g. the study of households in Cote d'Ivoire by Grimard 1997). Thus, it is not unreasonable to assume that communal lands households lack access to credit or insurance, formal or informal, and neither do they have access to resources from the rest of the world. The "precautionary saving hypothesis" (Gersovitz, 1988; Zeldes, 1989a; 1989b; Fafchamps et al 1998) suggests that when future income is random, and in the presence of borrowing constraints, households accumulate assets which serve as buffer stock to protect consumption.

Consider a household *i* which in time period *t* is endowed with "cash-in-hand"(following Deaton 1991) in the amount of X^i_t, consisting of current income, plus liquid wealth W^i_t which is end of period wealth for period *t-1* , and consists of livestock, grain stocks, jewellery, farm equipment and cash[4], however, measured in grain-equivalent[5]. After paying for present consumption, the wealth and income balance will constitute end-of-period wealth W^i_{t+1}. Wealth W^i_t yields a return r^i_t, whose distribution depends on the level and composition of the household's portfolio. With its income subject to risk, and with the presence of borrowing constraints, the household will not allow negative assets in any period. The household's intertemporal consumption decision is a dynamic problem programming (i.e. optimisation over time), whereby the household maximises lifetime utility by choosing consumption in each period such that enough wealth is carried over (given the process that governs wealth - crop income and returns to asset holdings) to ensure optimal consumption in subsequent periods including the terminal period (Dixit, 1990). When wealth consists of a single asset, the maximum value function $V(X^i_t, s_t)$, also known as the Bellman equation corresponding to the household *i*'s consumption decision problem, can be written as:

$$V^i(X^i_t, s_t) = \underset{W^i_{t+1}\geq 0}{Max}\, U^i(X^i_t - W^i_{t+1}) + \frac{1}{(1+\delta^i)} EV^i[y^i(s_t) + (1+r^i_{t+1})W^i_{t+1}, s_{t+1}\} \qquad (2)$$

[4] The focus is on liquid wealth because households can easily covert this wealth for consumption purposes. Therefore wealth in immovable assets (e.g., land, buildings etc., is ignored because such assets likely cannot be easily liquidated.

[5] This is necessary to simplify the model (e.g., need to consider a single interest rate).

following Fafchamps et al (1998). The Bellman technique utilises an iterative technique. The household is assumed to select an optimal strategy for the final period *T,* and given this strategy, the household selects the optimal strategy for period *T-1*, and so on. Assuming there is no bequest motive, all assets are liquidated at the end of the household's time horizon (T), in order to maximise current consumption.

The solution to equation 2 gives the optimal state-contingent consumption function. Equation 2 can also be used to analyse household savings behaviour under risk. When utility is assumed to be of decreasing absolute risk aversion utility form, its third derivative is non-zero, specifically $U'''(c) > 0$; that is, marginal utility is convex. Convex marginal utility generates prudence/ a "precautionary" motive for asset accumulation (Deaton, 1992; Fafchamps et al, 1998; Gersovitz, 1988; Zeldes 1989b), which means a household that anticipates being unable to borrow when it faces negative shocks to its income in the future may reduce its present consumption relative to the level when income is certain, and transfers the savings to future consumption periods. The certainty equivalence model (permanent income/ life-cycle hypothesis) says that for sufficiently large wealth, consumption is proportional to permanent income, and consumption in each period will only change by an amount equal to the annuity value of expected future wealth (Hall 1978; Hubbard et al., 1994; Zeldes, 1989b). Asset accumulation and liquidation provide a means to protect consumption against transitory income shocks. When assets have declined beyond a certain threshold level, they will cease to serve as a buffer stock and consumption begins to trend with income (Zeldes, 1989b; Deaton, 1991). For example, following a bad season a cattle-owning household may decide against selling the last pair of oxen (minimum required to supply draught power) or may decide to retain some cows for breeding stock. Since the model shows that the level of consumption depends on wealth and that the evolution of asset stocks depends on the sequence of income shocks, testing whether or not asset purchases and sales respond to income shocks has been used as a way of testing the hypothesis that rural households use assets as buffer stock (Fafchamps et al 1998; Paxsons, 1992; Rosenzweig and Wolpin, 1993).

Rural households in developing countries may choose from a variety of assets to use as a vehicle for accumulation, including livestock, grain stocks, demand deposits and

cash holdings. The optimal asset portfolio is influenced by the asset-attributes, such as the liquidity of the asset, the riskiness of returns and ability to use the asset directly as an input in production. In Zimbabwe very few communal lands households operate bank accounts. Banks limit their operations to urban areas and a handful of the larger rural service centres (Growth Points) dotted across the country. The post office savings bank, while its rural presence is significant, has branches that serve a very wide geographic area which require people to travel long distances to use their services. Furthermore, high rates of inflation such as has been experienced in Zimbabwe in the past decade, may act as a disincentive for holding large cash balances. Land sales in the communal lands are legally prohibited, although informal sales do take place. However, increasing scarcity of land in the communal lands means that it will be difficult for a household to reacquire land should it decide to re-enter farming in the future. Thus, land sales are unlikely to be viewed as a means by which to cushion consumption. Livestock and grain stocks are the most readily available assets for communal area households. Moreover, grain storage has the advantage of providing insurance against food price fluctuations (Jayne and Chisvo 1991; Scoones et al 1996), while cattle may be used as a productive input in farming, supply milk and other products, and produce offspring. In addition, cattle can easily be sold to buy food or meet other emergency cash needs.

It is assumed that households hold their wealth in two assets: livestock and grain stocks. Available storage technology and local climate typically result in negative inter-year return to storage of food crops. Therefore, only small stocks of grain are likely to be kept for seasonal consumption smoothing. Let τ denote the return to grain stocks[6]. Returns to livestock depend on weight gain and births, the supply of products such as milk, manure and hides, and draught power and on the price of livestock relative to grain prices (P_t). These returns vary with time and across households and are denoted by η^i_t. Relative prices depend on factors that affect the demand and supply of livestock and grain.

[6] As in Fafchamps et al (1998), it is assumed that τ is constant, an assumption that helps to capture the fact that grain stocks provide better protection against food price fluctuations than livestock, albeit a simplistic way of accounting for this effect.

The demand for livestock stems from the desire by farmers to invest in cattle and the demand for meat, particularly in the urban sector. Since the focus is on asset buffering behaviour of households, only the demand for cattle by farmers is explicitly modelled here. The effect of urban meat demand on communal lands livestock prices is treated as exogenous, and depends on the extent of integration in the livestock markets across the country (Fafchamps *et al*, 1998). Due to the biological nature of livestock production, there is a time lag from when farmers make production decisions to satisfy demand and when the livestock are finally ready for the market. The lagged effects in the demand and supply of livestock causes prices to be correlated over time (Rosen *et al* 1994). Cattle-keepers may be exposed to the risk of sudden collapse in the re-sale values of their livestock during droughts when large numbers of cattle are brought on the market to allow farmers to purchase grain. Combined with reduced grain supplies there can be a severe deterioration in the terms of trade between livestock and grain during periods of drought (Sen 1981). In order to capture these characteristics of the livestock market, price is expressed as a function of shocks: $P_t \equiv P(s_t|s_{t-1})$, following Fafchamps *et al* (1998).

Livestock production is risky, with the return affected by disease and the quality of pastures (Barrett 1992). Since pasture quality varies with current and past rainfall, the return to herding depends on s_t and s_{t-1}, $\eta^i_t \equiv \eta^i_t(s_t|s_{t-1})$. In the communal lands of Zimbabwe, the major variable costs associated with herding are the cost of labour and for dipping (to control ticks and other pests that may affect cattle), since grazing takes place mainly on communal pastures. The amount of labour required for herding, and the cost of dipping are assumed to vary in proportion with the number of livestock, $(\gamma+v^i)L^i_t$, where v^i is the shadow price of labour (value of labour measured in terms of its returns in crop production or off-farm employment) and γ is the cost of dipping per head of cattle. It is assumed that the cost of herding and dipping does not fluctuate widely, a reasonable assumption given that labour for herding is usually supplied by household members - mostly children and young adults. Cattle dipping takes place at communal dip tanks managed by the Department of Veterinary Services, which sets the fee per head of cattle for the service.

Assuming that households' liquid wealth (in grain equivalent) is divided up into a portfolio consisting of cattle and maize, at the end of period *t* household *i* will use some

of its liquid wealth to purchase L^i_{t+1} head of cattle at price P_t and keep the remainder of its wealth (W^i_{t+1} -L^i_{t+1} P_t) in grain form. The combined return generated by the portfolio can be expressed as:

$$(1+r^i_{t+1})W^i_{t+1} = (1-\tau)(W^i_{t+1} - L^i_{t+1}P_t) + (1+\eta^i_{t+1})L^i_{t+1}P_{t+1} - (\gamma + v^i)L^i_{t+1} \qquad (3)$$

Fafchamps *et al* (1998) use a similar expression to investigate the relationship between a household's total liquid wealth and one of the components constituting its portfolio. The theoretical and empirical evidence reviewed so far suggests that households do indeed use liquid wealth to insure (to varying degrees) their consumption against exogenous income fluctuations (Deaton 1991;Deaton 1992; Dercon 1998; Alderman and Paxson 1994; Morduch 1995). In the case of the communal lands in Zimbabwe, the foregoing discussion has established that grain stocks and livestock are likely to be the major forms in which wealth is held, and that livestock are a particularly attractive investment good. The next step in developing the analytical framework that facilitates testing the buffer stock role of cattle among communal households is the modeling of how a household chooses an optimal portfolio of grain and livestock. The household's portfolio allocation decision, how much of its liquid wealth to keep in the form of cattle L^i_{t+1}, is resolved at the same time (simultaneously) as the household's choice of the amount of liquid wealth W^i_{t+1} to hold. This aggregate saving decision is represented in notation in equation 4 which is obtained by replacing the return to liquid wealth component in the value function in equation 2 by its value given by equation 3 following Fafchamps *et al* (1998). This can be written as:

$$V^i(X_t, s_t) = \underset{W^i_{t+1}\geq 0}{Max}\left[\begin{array}{l} U^i(X^i_t - W^i_{t+1}) + \\ \underset{L^i_{t+1} s.t. W^i_{t+1}\geq P_t L^i_{t+1}\geq 0}{Max} \delta^i EV^i\left[\begin{array}{l} y^i(s_{t+1}) + (1-\tau)(W^i_{t+1} - L^1_{t+1}P_t) + \\ 1+\eta^i_{t+1}L^i_{t+1}P_{t+1} - (\gamma+v^i)L^i_{t+1}, s_{t+1} \end{array}\right] \end{array}\right] \qquad (4)$$

In order to focus on the relationship between liquid wealth and the cattle aspect of the portfolio, it is assumed that the level of aggregate savings W^i_{t+1} is given[7]. To obtain further insight about how the portfolio allocation problem is solved, the approach used by Fafchamps et al (1998) of using a mean variance-variance approximation of the expected value function in equation 4 is applied here[8]. Let $E[V^i(X)] \approx E[X] - \frac{1}{2} A^i \Sigma[X]$ where $\Sigma[X]$ is the variance of X and A^i is the coefficient of absolute risk aversion $-[V^{i\prime\prime}(E[X])]/[V^{i\prime}(E[X])]$. The value of physical returns to herding has an expected value $E[(1+\eta^i(s_{t+1}|s_t))\, p(s_{t+1}|s_t)]$, and variance $\Sigma[(1+\eta^i(s_{t+1}|s_t))\, p(s_{t+1}|s_t)]$ which may be denoted as $1+\bar{\eta}_i(s_t)$ and $\sigma^2_{Li}(s_t)$; respectively, for notational simplification; and the mean crop income and variance are denoted as $\bar{y}_i$ and σ_{yi}^2, respectively. Since cattle pasture and crops are subject to the same rainfall shocks, livestock returns and crop income are likely to be positively correlated. Let as $\theta_{yL}(s_t)$ be the correlation coefficient between crop income and livestock returns. The household's portfolio allocation rule (or the approximation to the decision rule) can be obtained by solving the following maximisation problem:

$$\underset{L^i_{t+1} s.t. W^i_{t+1} \geq P_t L^i_{t+1} \geq 0}{Max} \; \bar{y}^i + (1-\tau)W^i_{t+1} + (1+\bar{\eta}^i(s_t) - (1-\tau)P_t - (\gamma + v^i))L^i_{t+1} - 1/2 A^i(\sigma^2_{y_i} + \sigma^2_{L_i}(s_t)(L^i_{t+1})^2 + 2\theta^i_{yL}(s_t)\sigma_{y_i}\sigma_{L_i}(s_t)L^i_{t+1}) \tag{5}$$

An optimum value for L^i_{t+1} requires that:

$$L^{i*}_{t+1} = \frac{1+\bar{\eta}^i(s_t) - (1-\tau)P_t - (\gamma + v^i) - \theta^i_{yL}(s_t)\sigma_{y_i}\sigma_{L_i}(s_t)}{A^i \sigma^2_{L_i}(s_t)} \tag{6}$$

---

[7] As Fafchamps *et al* (1998) point out, the assumption simplifies the model, since in fact W_{t+1} depends the return to wealth r_t, which itself is depends on the choice between cattle and grain in the household's portfolio (thus W_{t+1} actually depends on L_{t+1}).

[8] The assumptions under which the mean-variance approach may provide reasonable approximation of the value function are also discussed in Fafchamps *et al* (1998). These include, for example, that the utility be nearly exponential and that the returns to wealth are normally distributed.

Equation 6 is a meaningful asset (cattle) demand function. As would be expected, the demand for cattle as an investment good is an increasing function of expected returns $\overline{\eta^i}(s_t)$ and storage losses τ; and a decreasing function of the livestock purchase price P_t, labour costs ν^i and dipping costs γ. Also, a high correlation coefficient between crop income and cattle returns $\theta^i_{yL}(s_t)$, high variance of cattle returns $\sigma^2_{Li}(s_t)$, and strong aversion for risk A^i, all have the effect of decreasing the investment demand for cattle.

It was assumed that the household function utility is of the decreasing absolute risk aversion form, which means the coefficient of absolute risk aversion A^i is a decreasing function of wealth. Thus, *ceteris paribus*, the investment demand for cattle represented by equation 6 is an increasing function of wealth W^i_{t+1}. There is also the question of whether the share of cattle in the household's portfolio increases or decreases as aggregate savings increase. Because there are some risks associated with raising and marketing cattle, the decision as to whether or not to increase the share of liquid wealth allocated to cattle when aggregate savings increase, depends on the household's relative risk aversion (whether the household is more or less willing to risk a specific fraction of its wealth as its wealth increases). When considering small changes in wealth, it is reasonable to assume constant relative risk aversion (Varian, 1992). It will be assumed that cattle constitute a constant proportion of household wealth. This means that households will respond to a negative shock to its income by selling cattle roughly in proportion to its share of liquid wealth. Fafchamps et al (1998) analytically demonstrate this result in their model of the aggregate savings behaviour of Burkinabe households. This prediction provides further rationale for developing a test of whether cattle provide a means to smooth consumption for households who lack access to contingency markets. The application of such a test and the results using data from the communal lands in Zimbabwe is presented in the sections below.

Application of the Model to Zimbabwe's Communal Land Households

Description of Study Sites

The analytical framework developed in the preceding section is used to examine the cattle transactions of a sample of farmers in the communal lands of Zimbabwe between the period 1992 and 1996. Using sample survey methods, data were collected on crop production and cattle transactions from 618 households in two wards in two different agro-climatic zones[9] in Zimbabwe. These zones differ in soil quality, annual rainfall patterns, and population densities. Mangwende Communal Lands in north-eastern Zimbabwe in Mashonaland East Province (Appendix A) lies in Natural Region II which is characterised by relatively high average annual rainfall (900 mm per year), fertile soils and relatively high land productivity. This area is located about 120 km from Harare (the largest city in Zimbabwe) and is linked by a good tarmac road. The population density is relatively high, averaging 40 people per square kilometre (the average for all communal lands is about 31 people per square kilometre). On the other hand, Chivi Communal Land in Masvingo Province (southern Zimbabwe) lies mostly in Natural Region V and is characterised by low rainfall (650 mm or less per year on average, with frequent droughts and mid-season dry spells), sandy soils and low productivity.

The farming system in most communal lands is characterised by rain-fed agriculture. Although there is a significant amount of irrigable land in many communal lands, it remains undeveloped due to serious water shortages. Cropping takes place in the summer months of November and December, and harvesting takes place at the end of the rain season in April (slightly shorter in Chivi). Each household has one main field, and sometimes crops are grown in the area around the homestead (home field). For the sampled households, the average farm size is 2.8 hectares in Mangwende and 3.39 hectares in Chivi. The predominant crop in all areas is maize, even though it is not well suited to the generally arid conditions in Chivi. Besides maize, farmers in Mangwende also grow groundnuts and sunflower, while in Chivi groundnuts and sorghum are the alternative crops. Sunflower is a cash crop and was widely promoted to small growers in

the communal lands in the early 1980s with producer prices guaranteed by the government. Since the removal of price supports, fewer farmers grow sunflower. Groundnuts are grown primarily for home use and in general take a negligible fraction of total cultivated land. Sorghum flour is sometimes used for *sadza* (a thick porridge eaten with meat and gravy or cooked vegetables), the staple in Zimbabwe, in place of the preferred maize meal.

There are active markets for agricultural output in both regions. The Grain Marketing Board (GMB) (a government owned corporation) is the main buyer for maize grain, and also buys a wide range of other commodities including sunflower, sorghum and groundnuts. With the deregulation of agricultural marketing which came into effect beginning in 1995, a number of private sector participants have emerged and are involved in purchasing agricultural commodities in most communal lands. Livestock (cattle, goats and sheep) can be sold to local butchers, to the Cold Storage Commission (CSC) (a government owned corporation, and the major meat processor in Zimbabwe), and to other villagers. However, land transactions are not legally sanctioned and labour markets are not well developed. Credit, insurance and other formal financial markets are generally unavailable. Households in ward 20 - the survey site in Mangwende have to travel about 28 km to get to the nearest bank branch or a branch of post office savings bank at Murehwa Centre, while households in ward 14 in Chivi have to travel about 30 km to Chivi Centre.

Most of the farmers that were surveyed are poor and face high income risk. Mean crop income (a major component of household income) per household is about Z$2 500 (less than 250 US dollars[10]). Crop income in both sites is highly variable. For example, the average year-to-year coefficient of variation across all households is 129% in Mangwende and 95% in Chivi. Most of the income fluctuation is due to rainfall variation, with ill-health for members of the household during the cropping season, pests and price fluctuations being other contributory factors. Table 3-1 shows that between the years 1992 and 1996, Mangwende experienced two years of below average rainfall, the

[9] Agro-climatic zone refers to a geographic area distinguished from other areas on the basis of temperature, rainfall, soil and vegetation type. Since the factors are related to region's ability to support plant growth., agro-climatic zones are also distinguished on the basis of their agricultural potential.
[10] 1996 exchange rate of US$ 1.00 : Z$13.00

severest being in 1992 which coincided with one of the worst droughts that Zimbabwe has experienced in recent times. This followed after Mangwende had received only 63% of its normal rainfall in 1991. In all but one year, Chivi experienced less than normal rainfall, with 1992 being the worst on record. These aggregate shocks are partly responsible for the income risk discussed above. Because of poor rains, food aid inflows were required in Mangwende in 1992, while food aid was required over the entire period for households in Chivi.

Table 3-1: Regional rainfall (mm)

Communal Land	1992	1993	1994	1995	1996
Chivi	283	425.3	476	496	622
(As proportion of long term average)	(0.57)	(0.85)	(0.95)	(0.99)	(1.24)
Mangwende	654.1	915.8	933	698	1017.5
(As proportion of long term average)	(0.73)	(1.08)	(1.10)	(0.82)	(1.20)

Source: Department of Agricultural and Extension Services (AGRITEX) reports.

The variability in rainfall during the survey years presents an opportunity to examine the relationship between aggregate income shocks and asset transactions. The major asset that communal land households possess is cattle (many households also own small stock: goats, sheep and fowl). During the survey, information about household cattle ownership, such as herd structure (number of cows, calves, heifers, steers, oxen and bulls), animal births and deaths, livestock consumption, purchases and sales and reasons/ motives for sale was collected for a period covering a five-year between 1992 to 1996. Data on the number of goats owned, births, sales, and consumption in each year over the same period was also gathered. Even though the survey was conducted in 1997, constructing the five-year data panel was possible because livestock transactions are discrete, infrequent and generally easy to remember. Farmers have an intimate knowledge of all their cattle and each head of cattle is usually identified by a name.

Information concerning livestock inventories for the study sites is summarised in Table 3-2. Cattle and goat holdings are quite low in both regions. The average cattle herd size is higher in Mangwende, but farmers in Chivi own more goats on average. Mean sales and purchases of both goats and cattle are very small, and most households neither sold nor purchased livestock during the survey period. Such low numbers are unexpected if cattle sales are used to smooth consumption. Although goat transactions are marginally

more frequent, at an average of 0.3 goats sold per household per year and given that a goat sells for substantially less than a cow, income from goat sales contribute a very small amount towards offsetting the drop in income due to drought. Among the sampled households, 60% owned cattle at the beginning of 1992, and 20% of them sold at least one head of cattle during the survey period. By the end of 1996 about 60% of the households still had cattle. Most households therefore would have been able to use the sale and purchase of animals to smooth consumption. Given that 1991 was a bad season (Mangwende received only 63% of its normal rainfall and 50% in Chivi), most households are unlikely to have had significant stocks of grain carried over from the previous year, to help cushion the impact of the reduced harvest in 1992, and in subsequent years. In this sense, the sample provides an opportunity to investigate whether or not households use livestock sales and purchases to respond to transitory income shocks.

Table 3-2: Livestock characteristics by household[a]

	1992	1993	1994	1995	1996
	Mean	Mean	Mean	Mean	Mean
Livestock Inventories					
Chivi					
Cattle Ownership	1.3	1.4	1.7	1.9	2.3
Cattle Sales	0.1	0.1	0.1	0	0
Cattle Purchases	0	0.1	0.1	0	0.1
Goat Ownership	4.2 (1)	4.3	4.7 (1)	5.5 (3)	7.1 (6)
Goat Sales	0.6	0.3	0.3	0.3	0.3
Goat Purchases	0.1	0.2	0.2	0.3	0.5
Mangwende					
Cattle Ownership	4.4 (3)	4.3 (3)	4.5 (3)	4.4 (3)	4.3 (3)
Cattle Sales	0.1	0.2	0.1	0.1	0.1
Cattle Purchases	0.1	0.9	0.1	0	0.1
Goat Ownership	0.8	0.9	0.8	0.9	0.9
Goat Sales	0.1	0	0	0.1	0.1
Goat Purchases	0	0	0	0.1	0.1

[a] The figures in parentheses are standard deviations, where the standard is not given the value is 0.

Description of the Data and Data Collection Methods

The analysis is conducted on crop income and cattle transactions data for the period January 1992 to December 1996. It is important to be able to track households over a period of years because the income and consumption smoothing hypotheses are essentially propositions about individual behaviour over the long-run.

All of the data were collected during the period August - September with the assistance of a survey team of eight research assistants (four from each study site). Before the survey was undertaken, the research assistants underwent a week of training during which the objectives of the study were explained. The research assistants were also taught the techniques for administering surveys as well and general research etiquette. At the end of the training period the research assistants participated in a pre-test of the questionnaire that was carried out in a location separate from the actual survey site, during which they gained some experience before participating in the real survey. To ensure the co-operation of the local peoples, consultations were held prior to conducting surveys with the District Administrators, District Agricultural Extension Officers, the ward councillors and the headmen at each of the sites. The councillors agreed to notify all residents about the presence of the research team in the ward, and to briefly explain the nature and importance of the research at ward meetings. Furthermore, the research assistants were selected from the respective wards because of their familiarity with their respective areas, and also because the local peoples are more willing to give information about themselves and their households to people with whom they are familiar. A Shona (the local language) version of the questionnaire was used during the survey.

The survey collected data from a total of 618 households: 228 from Chivi and 390 from Mangwende. Prior to conducting the interviews, the research assistants created lists of all the households in each ward, and a total of 694 households were shown to reside in ward 14 (in Chivi), while there were 907 households in ward 20 (in Mangwende). These household lists defined the population for the survey, and the sampling strategy was to interview every household who were home when the interviewer visited them (census).

The analysis in this study uses crop income and livestock transactions data for the period January 1992 to December 1996. The choice of January and December as reference points, instead of the cropping seasons that covers the period November to October, is influenced by the fact that the survey relied on recall to create the five-year panel data set. It is relatively easy for a household to recall events by the year in which they happened. Many events in Zimbabwe are timed according to the calendar year, for example, the beginning and end of the school year and the celebration of Christmas (about 80% of Zimbabweans profess to be Christians). Crops are harvested once a year,

except in areas where irrigation is practised. After harvest, crops are usually thrashed, winnowed and the output measured in buckets (using 20 litre cans) or bags (90 kilogram bags are widely used) in readiness for sale or storage. Cattle sales and purchases are large, discrete transactions and often each animal is identified by name, and generally farmers will easily relate the year-to-year life history of every animal. For the analysis that follows, cattle transactions are aggregated by year. L^i_t denotes the net sales of cattle by household *i* in year *t*.

Since cattle are but one item in the household's portfolio of assets and in the absence of information about other forms of wealth for each household and data on consumption, the analysis below does not test the ability of households to smooth consumption in the face of income shocks. Instead the test is whether or not households use cattle transactions as a buffer stock as suggested by the non-perfect market version of the life-cycle hypothesis.

Results

Cattle and Rainfall Deviation

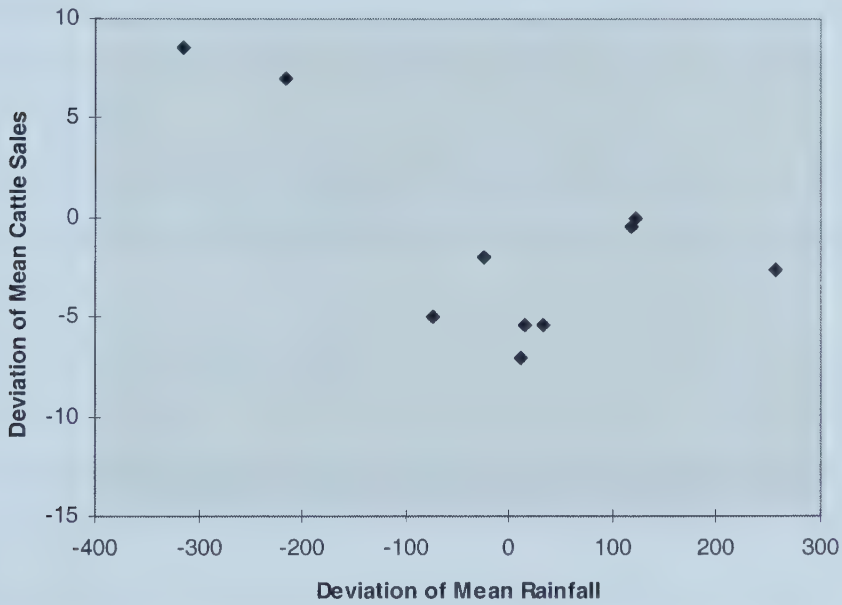
This section examines the relationship between income shocks as result of rainfall deviation and cattle transactions. This is accomplished first by analysing the relationship between rainfall deviation and net cattle transactions. Second, the effect of rainfall deviation on crop income is analysed using regression techniques in an attempt to construct measures of income shocks. Finally, the effect of income shocks on cattle transactions is examined in regression analyses.

Reliance on rain-fed agriculture leads to a strong correlation between crop income and rainfall. As suggested by the life-cycle hypothesis, in the absence of perfectly functioning credit and insurance markets, households are likely to invest in some stocks of liquid wealth which can be depleted to cushion consumption in the event of temporary shortfalls in income (income shocks).

Since variations in rainfall are considered an exogenous source of risk it is expected that there is a correlation between rainfall deviation and net sales of cattle. However, this theoretical expectation is not strongly supported by the data. Figure 3-1

displays the relationship between annual rainfall (measured in terms of deviation from its long-run average) and annual aggregate cattle sales (measured in terms of deviation from their five year average). There is no strong relationship between annual rainfall and annual aggregate cattle sales in both study areas. Given that the graphical analysis is based on 10 observations, the analysis does not provide definite evidence for the absence or presence of a consumption smoothing role for cattle sales. More rigorous analyses of the relationship conveyed in Figure 3-1 are conducted using regression techniques in sections that follow.

Figure 3-1. Annual village cattle sales and rainfall.



Estimates of Crop Income Shock

The hypothesis about households' use of cattle as a buffer stock is tested using three estimates of crop income shocks. The first estimate measures the effect of rainfall variation on total crop income, an approach that allows the identification of a component of income that is both exogenous and transitory. If the life cycle hypothesis holds, negative transitory income should trigger the depletion of assets allowing the household to cushion consumption during a period of low income. The second income shock

measures the effect of rainfall on grain output (combined maize and sorghum output). If households indeed sell cattle in order to import grain to the village, then it can be expected that livestock sales would respond more sharply to variation in food availability than to shocks in total income including the component spent on acquiring non-food items. The third estimate of income shock relies on first identifying the permanent component of income and then estimating the yearly deviations from it as transitory shocks. Since this approach does not distinguish between aggregate and idiosyncratic shocks, this estimate can be considered an upper bound on the income shocks. It is important that aggregate and idiosyncratic shocks are distinguished because there are likely different strategies to deal with different types of shocks. Idiosyncratic shocks are likely to be dealt with through village risk-pooling, and shocks that affect the entire village in the same way are likely to be dealt with through the liquidation of the household's assets.

To derive the first two estimates of income shock (crop income and grain output), total crop income / grain output is regressed on measure of rainfall variation:

$$y^i_{zt} = \alpha_1 F^i_{zt} + \alpha_2 H^i_{zt} F_{zt} + \psi^i + \varepsilon^i_{zt} \qquad (7)$$

where y^i_{zt} denotes either crop income in Zimbabwe dollars or grain output in bags accruing to household *i* in region *z* in year *t*. H^i_{zt} is a vector representing household characteristics that are determinants of income, for example, the location and quality of the household's agricultural land, and F_{zt} is a ward level measure of rainfall variation consisting of the deviation of rainfall from its long run average. To account for the fact that the same levels of rainfall are likely to have different effects on production of different types of land, the cross-product $H^i_{zt}F_{zt}$ is included on the right hand side of the equation. The component ψ^i is a random disturbance characterising the *i*th household and is constant through time. The random disturbance factor captures all factors specific to the household that may affect income but are not in the regression. And lastly, the term ε^i_{zt} is a random error and uncorrelated to ψ^i. The third set of income shock estimates consists of the deviations of household income in year *t* from their 1992-1996 average.

If the regression in 7 above provides consistent estimates of α_1 and α_2, then

$\hat{y}^i_{zt} = \hat{\alpha}_1 F_{zt} + \hat{\alpha}_2 H^i_{zt} F_{zt}$ constitutes a consistent estimate of the transitory component of income for household *i* in ward *z* and period *t*. Since rainfall variation is but one source of income risk (other sources include, price variations, pests etc.), this estimate is a lower bound of the actual income shock experienced by households.

Estimates of crop income (first set of income estimates) obtained from equation 7 are presented in Table 3. The null hypothesis that there are no individual specific effects is strongly rejected: the Lagrange Multiplier statistic (distributed as chi-squared with one degree of freedom) is 1,799 with a level of significance $p= 0.00$. The rainfall coefficient is significantly different from zero. Rainfall also affects income through its interaction with the agro-climatic zone in which the households are located: the income of households in the higher rainfall ward is negatively affected by rainfall in excess of the region's long run average, probably due to the fact that the annual average rainfall for Mangwende is relatively high (900 mm), and rainfall levels far above the average will likely lead to crop damage. At the time of the survey in 1997, it was reported that too much rainfall in the previous cropping season (1,158 mm) had significantly reduced the year's crop harvest to the extent that many families needed to buy grain in order to meet their requirements until the next harvest. Rainfall also affects income through its interaction with ownership of assets used in farm production - such as the ownership of at least one plough. Ownership of a plough is essential for timely land preparation and planting, which is crucial in situations of erratic rains, and is also a proxy for ownership of draft animals.

The second column in Table 3-3 presents estimates of equation 8 using combined maize and sorghum output in bags as the dependent variable. The effects of rainfall on grain output are similar, although not as "strong" - both rainfall deviation and effect of rainfall through agro-climatic region are significant at the 10% level (to those of the total crop income). The hypothesis that there are no random effects is rejected (LM = 1,732.02, p=0.00).

Table 3-3:Random effects estimates of crop income and grain output

Variable	Crop income Parameter Estimates	t-ratio	Grain output Parameter Estimates	t-ratio
Constant	1522.4	70.603	21.528	18.560
Rainfall deviation	3.669	5.212	0.021	1.771
Rainfall deviation × Agro-climatic region 2	-3.461	-7.397	-0.015	-1.699
Soil quality	0.118	0.380	0.005	0.951
Home-field area	-0.083	-0.701	-0.002	-0.819
Plough ownership	0.528	1.309	0.014	2.117
Number of observations		618		618

Crop Income Shocks and Motivations for Selling Cattle

Households were asked detailed questions about each class of cattle (cows, calves, heifers, steers, oxen and bulls) including their reasons/ motivation for selling cattle. Using the income shock estimates based on the regression of total crop production value on rainfall deviation, responses were tabulated according to the severity of the shock faced by the household. Households cite a number of reasons for selling cattle as shown in Table 3-4.

Table 3-4: Reported motives for cattle sales

Income shock category	Bad Shock (%)	Medium bad (%)	Medium. good (%)	Good shock (%)
Reported motive for sale				
Consumption	44	36	28	19
School fees	29	26	23	26
Payment of medical expenses	7	10	11	12
Purchase livestock	9	14	17	16
Destocking during drought	4	0	0	5
Other	7	14	21	22
Total	100	100	100	100
Number of observations				618

Source: Survey data.

Of particular interest though, is that for those households who faced negative income shocks (1st and 2nd quartile) a relatively larger proportion reported the need to

purchase grain as the main motivation for selling cattle. About 44% of the cattle sold by those in the first quartile were sold for consumption purposes. Among those households who faced less severe income shocks, a variety of reasons for selling cattle were cited, such as payment of school fees, and no one particular reason was clearly dominant. The need to raise money for children's school fees ranked second highest as a reason for selling cattle among households who faced negative income shocks. These results seem to provide support to the buffer stock hypothesis; that is, households tend to liquidate assets in the face of income shocks.

Crop Income Shocks and Livestock Transactions

The determinants of cattle transactions are further analysed using the actual cattle transactions data. This is accomplished by estimating the following equation:

$$s_{zt}^{i} = \beta_0 + \beta_1 H_z^{i} + \beta_2 F_{zt} + \beta_3 \hat{y}_{zt}^{i} + \xi_{zt}^{i} \qquad (8)$$

where s^i_{zt} is the net number of cattle sold by household *i* in ward *z* and year *t*, H^i_z is a vector of household characteristics such as the demographic composition of the household and initial asset holdings, which might affect expected income, savings, and thus livestock transactions. F^i_{zt} stands for rainfall shocks consisting of deviation of current rainfall from the long-term average and lagged rainfall deviation. Current rainfall deviation is added to control for its possible direct impact on price and productivity of cattle herding through fodder and water availability. Lagged rainfall captures the equilibrium effects on livestock price (there are lagged effects in the demand and supply of livestock as an investment good) and past productivity shocks. $\hat{y}_{izt}$ is a measure of income shock (one of the three measures of transitory income shocks derived above). ξ^i_{zt} is a random error term. Equation 8 was estimated using both the ordinary least squares technique and random effects. The results are similar, but only the estimates from the random effects model are reported here.

Estimates of equation 8 are presented in Table 3-5. The determinants of cattle sales are estimated first using the effect of rainfall on the total value of crop production

(first two columns), and using the effect of rainfall on grain output (middle two columns), and in the last two columns using the income deviation.

Table 3-5: Second stage OLS estimates of the determinants of net cattle sales

Variable	Income shock due to rainfall		Income deviation from household mean		Grain output shock due to rainfall	
	Parameter Estimates	t-ratio	Parameter Estimates	t-ratio	Parameter Estimates	t-ratio
Constant	0.18002	1.126	0.17952	1.123	0.17958	1.123
Income shock	-0.00001	-0.157	0.00001	1.398	0.00385	0.552
Rainfall deviation	-0.00004	-0.398	-0.00006	-0.910	-0.00015	-0.763
Lagged rainfall deviation	0.00005	0.540	0.00004	0.460	0.00004	0.432
Total cultivated area	-0.00034	-0.088	-0.00035	-0.089	-0.00037	-0.094
Number of adult females	0.00014	0.011	0.00015	0.011	0.00019	0.014
Number of adult males	-0.02461	-2.113**	-0.02463	-2.112**	-0.02449	-2.099**
Age of household head	-0.00961	-1.365	-0.00961	-1.364	-0.00952	-1.352
Age of head squared	0.00013	1.835*	0.00013	1.835*	0.00013	1.823*
Dummy variable (Mangwende = 1)	-0.04013	-1.459	-0.04210	-1.609	-0.04434	-1.662
		2.94				
F-test statistic	F(9, 3079)	0.00	F(9, 3079)	2.92	F(9, 1753)	2.64
Level of significance				0.00		0.00
		618				
Number of observations				618		618

** significant at the 0.05 level
* significant at the 0.10 level

The coefficient on the income shock variable in column 1 suggests that this variable is not statistically significant in explaining net cattle sales by households. However, the point estimate indicates that households adversely affected by drought sell more cattle than other households. This effect is, however, small.

No statistically significant relationship is found between income shocks and cattle sales from the estimates of equation 8 using income deviation as the estimate for income shock. This apparent lack of a relationship between income shock and cattle sales is further confirmed by the estimates of equation 8 using grain output shock as the estimate for the income shock suffered by households. The sign on the income shock estimates in the last two cases is contrary to the sign that was expected, as is the positive sign that suggests that households adversely affected by drought are less likely to sell cattle than other households. A possible explanation for these results is that the relationship between income shocks and cattle sales is nonlinear. Estimating equation 8 using combined positive and negative income shocks masks such nonlinearities.

A number of factors suggest that treating cattle transactions as a continuous variable and the use of the ordinary least squares technique to estimate the model above may result in model misspecification. First, households sell cattle infrequently; and second, many households did not sell cattle during the survey period (the median cattle sales from the survey data is zero). Thus cattle sales are a discrete event. The possibility that results in Table 3-5 suffer from model misspecification may be tested by estimating equation 8 using a logit model. A binary logit model is used to estimate the determinants of the household's decision to sell cattle. This approach is chosen because surveyed households seldom sold more than one head of cattle if they did sell any at all, and few households sold cattle in more than one year in the period 1992 - 96. Thus the cattle sales data can be transformed into information on whether or not the household sold cattle during the survey period.

Results using the first income shock estimates (effect of rainfall on total value of crop production) are presented in Table 3-6. The regression of the binary variable reflecting whether or not the household sold cattle provides no evidence of a statistically significant relationship between income shock and the decision to sell cattle. However, the point estimate indicates that households that face an adverse effect from the drought are more likely to sell cattle than other households, but once again this effect is small.

Table 3-6: Logit estimates of the determinants of household's decision to sell cattle

Variable	Income shock due to rainfall	
	Parameter Estimates	t-ratio
Constant	-5.1485	-4.010*
Income shock	-0.00042	-1.186
Rainfall deviation	0.00065	0.0970
Lagged Rainfall deviation	-0.00011	-0.170
Number of adult females	0.19333	2.685*
Number of adult males	0.05038	0.768
Age of head of household	0.04568.	0.831
Age of head of squared	-0.00025	-0.443
Total cultivated area	0.04749	2.150*
Dummy (Agro-climatic region =1)	0.30373	1.639
Number of observations	618	
χ^2 statistic	43.54	
Correct Predictions (%)	94	

* significant at the 0.05 level

Conclusion and Recommendations for Future Research

The permanent income hypothesis predicts that household consumption is proportional to permanent income and that consumption is uncorrelated to transitory income. The theory also predicts that households that face income risk smooth their consumption through insurance or credit, and where perfect capital markets do no exist, households will use liquid assets for self-insurance. This hypothesis is examined for smallholder farmers in the communal areas in Zimbabwe. The results of the current study do not find evidence that households used cattle as buffer stock against income shocks induced by drought. Only a weak relationship between cattle sales and income shocks was revealed: those households adversely affected by drought were more likely to sell cattle in order to buy food. This suggests that cattle transactions play only a small part in consumption smoothing among communal area households.

The low rate of cattle sales from the communal agricultural sector has long baffled policy makers in Zimbabwe. One possible explanation of these results is the low number of animals per household, as shown in Table 3-2. In Chivi the mean herd size ranged from 1.3 to 2.3 during the survey period, while it was slightly higher at 4.4 in Mangwende. Since households need a minimum of 2 animals to supply draft power for

tillage, households are unlikely to sell any cattle if the head size is not significantly above this critical level. Thus liquid assets may only function as an effective buffer stock if they are above some critical level.

Another possibility is that households have at their disposal less costly strategies to deal with droughts, for example, reliance on remittances from family members in the urban sector. Indeed some studies show that remittances constitute about 25% of total income for the average communal area household. Among the surveyed households, 60% had at least one member employed in the off-farm sector. Also, the Zimbabwean government has often provided food aid in times of drought enabling households to stave off starvation. It may be that such food inflows are adequate to allow households to successfully smooth consumption. However, since 1997 the government has introduced new rules for drought relief programs. Only those households with small numbers of livestock, without non-farm income sources, qualify for drought relief that is in the form of grain loans to be repaid after the next successful harvest. This policy may, in the future spur more households to sell cattle to buy grain during droughts.

It is also possible that small livestock (goats and sheep) are perceived to be more liquid than cattle, and households find it less costly to sell small stock in order to purchase food. In the study sites, households owned goats, but the average flock size was small - average from 4.2 to 7.1 animals per household in Chivi and about 1 head in Mangwende during the survey period (Table 3-2). Few households sold goats during the survey period and the mean number of goat sales was 0.6 animals in Chivi and much lower in Mangwende. The median number of goats sold was zero. It is unlikely that small stock would have played a much larger role in households' consumption smoothing strategies.

Although the present study attempts to shed some light on mechanisms used by households to insulate consumption from income fluctuations, the present study is limited by the lack of data about alternative risk mitigation strategies available to communal area households. There is need to gather empirical data on the use of credit markets, remittance flows and the role of human capital in risk reduction. Additionally a better understanding of the functioning of livestock markets in the communal areas is necessary since they affect the ease with which animals can be disposed of, and the prices that

household can get for their animals. Incomplete (thin or absent) livestock markets render livestock investments irreversible or at least not as liquid as is commonly assumed in the literature.

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CHAPTER 4

Examining the Determinants of Evolutionary Changes in Landholders' Property Rights: A Case study of Communal Land Tenure in Zimbabwe

Introduction

The way in which a society allocates control over resources and their use among economic agents, including those representing the government, affects resources allocation and the level of economic output (Anderson and Hill, 1975; Eggertsson, 1990). By defining the identity of rights holder and the types of rights over resource granted them (e.g. the right to use and to derive income, to transfer, and to exclude others from one's property, etc.), the institutional arrangements used by a society to guide resource use define the society's ownership/ property rights structure. The economic importance of a society's property rights structure derives from the fact that property rights affect the incentives faced by economic agents and their economic behaviour. Property rights influence the opportunities available for resource owners, and the ability of individuals to capture the benefits produced by their assets. Because property rights can influence economic behaviour and economic activity through their effect on incentives, governments in their role as social planner (welfare maximiser), and as an interested party (user of resources), and individuals seeking to maximise their utility/ wealth, will all have an interest in the structure of property rights in the economy.

The arrangements under which land is held and used are referred to as land tenure. Different land tenure systems (modes of tenure) exist in different societies and at different times. Land tenure systems have been categorised into broad categories such as communal tenure, state property and private property, using the identity of the right holder and the content of the ownership right as the basis of classification. Still, other classificatory systems distinguish between land tenure (rights in the productive asset) and tree tenure (i.e. rights in other resources found on the land) (Bruce and Fortmann, 1988). The objective of developing these classes of tenure is to describe property rights systems

observed to exist in different societies and to predict the social consequences that may flow from them. The differences between tenure types are in the identity of the right holders and the type of existing rights. For example, under what is referred to as the communal tenure system, control of the land is by the community, which allocates specific plots of land to each household. In some situations control of the land is by individuals who have the right to exclude others, and to alienate land under agreed terms to others. In yet other cases the control may be held by the state which may have the possibility to exclude others from its property.

Despite the obvious convenience from the view-point of quick communication, such a classification of property rights masks the variety and complexity of the ownership relationship. This is because the ownership right is really a bundle of rights. This bundle of rights is divisible. As pointed out above communal tenure includes the right to exclude others from arable lands during the growing season, while other rights such as the right to collect wild products are shared with other members in the community. At the same time, while private property rights seem to carry the notion of absolute rights, in reality this may not be the case, because individuals are unlikely to find it worthwhile to enforce all possible rights, since resources have to be devoted to this enforcement. The cost of enforcing all rights may outweigh the benefits. Clearly the classification of property rights regimes into such lumpy categories can be confusing and also fails to increase our understanding of the effects of alternative property rights systems.

It has been argued that description of property rights systems might be better undertaken using frameworks that show the interconnectedness of ownership rights, incentives and economic behaviour. Such analytical frameworks and schema are based on the fact that the bundle of property rights is divisible, suggesting that the content of the right of ownership can be changed, and the degree to which each right is defined can be varied (Luckert and Haley, 1990; Kundhlande and Luckert, 1998). The implication of such an approach for describing and analysing property rights is the recognition that the structure of property rights can be changed by changing the rights contained in the ownership right (e.g. right to transfer land rights to others at agreed terms, etc.), and by changing the degree to which each right is defined (e.g. to include the right to exclude others from one's property at any time, not just during the cropping season).

The property rights observed in a society at any one point in time are likely to be the result of the evolutionary responses of humans in attempting to solve the problems caused by scarcity, technical innovation, and the opening of new markets. Right holders respond to changes in market forces by changing their rights into the most valuable form. Changes in property rights are necessitated by changes in relative prices, caused by changes in technology and preferences. Such changes lead to a dysfunction between existing property rights structures and the current socio-economic circumstances. The effect of the dysfunction is that there may be some benefits that cannot be captured or costs that cannot be avoided under the existing institutional arrangements. In such situations it will be expected that individual right holders will attempt to modify their bundle of rights to enable themselves to respond fully to the new costs and benefits. Sometimes the government may supply institutional changes in order to minimise conflicts over resource use among economic agents.

This chapter attempts to explain the development of individualised land rights using a case study of communal areas in Zimbabwe. Individualisation is described as a process in which more rights are removed from the community to individuals or households (Bruce, 1985; Angelsen, 1997). Further, related to this development, rights of individuals in land are defined explicitly and in more detail (Kundhlande and Luckert, 1998), for example, the creation of firm boundaries around fields. The study also explores the link between investment in land and tenure security, specifically, whether investment can be a way of acquiring rights to transfer land without community sanction and of establishing a secure claim to land. The property rights literature, and numerous empirical studies do not seriously consider this issue (what Besley (1995) refers to as the reverse causation), only focusing on the role of property rights (in particular the security of land tenure) as a determinant of investment. To investigate the endogeneity of land rights, the case study examines the determinants of the land rights enjoyed by individuals.

The rest of the chapter is organised as follows. First, a brief description of the property rights approach to economic analysis is outlined. The property rights theory underpins the discussion of land ownership issues and the evolutionary processes that lead to changes in a society's land ownership structure. This is followed by a discussion of the motivation for the present study. There is increasing discontent with the current

land tenure systems in the communal lands in many developing countries, especially in their inability to generate adequate incentives to encourage efficient utilisation of land and other resources. Many countries are at present engaged in efforts to modify their land tenure systems (in many cases with the support of multilateral agencies, such as the World Bank) as an integral part of a broad strategy to spur economic growth and development. Often, such efforts are not informed by a good understanding of the forces that lead to the emergence, maintenance and the decay over time of property rights regimes. An overview of the history of Zimbabwe's communal lands is then presented and a description of the land tenure rules controlling land use in the subsector, as well as a description of the evolutionary changes in landholders' rights which have been taking place in the past decades. A model of endogenous land rights (the deployment of internal mechanisms for altering tenures) is presented. The model predicts that decision variables such as the level of investment in tenure defining activities may be used to determine the degree to which land rights are specified. An empirical application of the model to the communal lands of Zimbabwe and the results are presented. The last section concludes and provides some suggestions for further research.

The Property Rights Approach

The problem motivating this study is the perceived inadequacy in the current land tenure system in the communal lands by governments and by right holders. For the government the evidence of the inadequacies is the lack of increased production, and environmental and natural resource degradation; and for individual rights holders inadequacies are manifested in the form of constraints preventing them from maximising the value of their resources. The presence/ emergence of values and opportunities to enhance asset values that cannot be exploited under the current set of institutions creates incentives for the government and right holders to attempt to achieve property rights that would serve their respective principal goals. For the government, these goals may include improvements in general welfare, social stability, and vote maximisation. Iindividuals may seek to maximise the value of their resources or the utility derived from consumption/ utilisation of the resources. To understand the decisions of economic agents

regarding the definition of land rights (establishment of basic rights in land, and subsequent modifications of these rights), and enforcement of the rights, there is need for an analytical framework that links institutions, and incentives and economic behaviour. Such an analytical framework may be found in property rights theory.

Recognition of the interconnectedness of ownership rights, incentives and economic behaviour has led to the development of an alternative analytical approach (in contrast to the traditional theory of production and exchange) for analysing economic problems. This analytical framework focuses on the role of ownership or property rights, hence the property rights approach, to economic analysis. The three fundamental building blocks of this approach are discussed in Furubotn and Pejovich (1972). First, the approach emphasises the key role individual decision makers play within productive organisations, instead of the organisation *per se* being the unit of analysis. Individuals posses the capacity to evaluate alternatives and to adjust to the economic environment they face before selecting an option that will maximise utility (wealth). Second, unlike traditional theory which assumes the existence of a single pattern of property rights, thus assuring a wealth maximising outcome, the property rights approach takes into account the fact that more than one pattern of property rights can exist. This means that the same level of input usage and technology is capable of producing a different amount of output under a different institutional environment. The third building block of the property rights approach is the recognition of the presence of transactions costs (costs of gathering information, contracting, and enforcing contracts) in production and exchange processes. Positive transactions costs will tend to reduce the opportunity set (the set of options that can be undertaken profitably) of right holders, and lower the amount of rent (economic surplus) that can be captured from chosen alternatives. Economic agents will seek to maximise utility by choosing to undertake those activities for which transactions costs are the lowest, as well as to actively seek to modify the content (bundle of rights) of their ownership right in order to reduce transactions costs. Combining the assumption of utility maximising individuals, the possibility of multiple patterns of property rights, and positive transactions costs, an optimisation model can be formulated which can be used to explain the behaviour of economic agents.

The application of this framework is analogous to, but distinct from, the usual profit maximisation case. The objective function to be maximised is the decision maker's utility function, defined to reflect his/ her preference. The problem becomes that of maximising the utility function subject to the constraint imposed by the opportunity set, that is the actual options attainable to the decision maker (e.g. the degree to a which a landholder can exclude others) which are determined by property rights laws and the costs of enforcing exclusivity. An appropriate specification of the decision maker's utility function will have among its arguments the type of rights included in the ownership right's bundle of rights (e.g. it is likely that one's enjoyment of a house is higher if others are prohibited from building factories in the proximity). Thus, a change in the structure of property rights is likely to affect the actions of an owner of a resource/ asset and also generate incentives for him/ her to influence the structure of property rights.

This analytical approach provides some useful insights into the evolution of property rights, and the effect of the structure of property rights on the allocation of resources, the composition and distribution of output, and on the evolution of property rights. The divisibility of the bundle of rights, and the presence of transactions costs in the definition and enforcement of property rights means only those rights whose marginal value (net benefits from increased definition of the right) is positive will be enforced. Thus, since the definition and enforcement of property rights uses up resources, a given structure of property rights will emerge and be maintained only when the benefits of specifying and enforcing the rights exceed the costs of doing so. This approach provides a framework for evaluating different institutional arrangements and predicts a systematic evolution of property rights. Thus, the determinants of property and their consequences can be investigated.

Demsetz (1967) develops a theory of property rights which predicts that laws that define and enforce rights and duties regarding an economic asset appear when the good increases in value. A number of empirical studies and historical processes support this assertion (e.g. Anderson and Hill, 1975; Ault and Rutman, 1993; Alston *et al*, 1996). Individuals defend their rights by keeping away non-owners and by enforcing contracts. Since definition and enforcement of property rights is costly, a person will do so if it is

profitable. Anderson and Hill (1975) model the optimum level of private enforcement activity as a function of marginal costs and marginal benefits.

As individuals increase their efforts to protect their rights, the total demand for the society's provision of well-defined property rights increases. The community or an outside authority, for example, the state, can exploit economies of scale and provide property rights institutions at a relatively lower cost, allowing individuals to use more of their resources in productive activities and less towards enforcement of property rights.

The property rights theory also provides a model for the evolution of rights to land. Landholders will invest more resources in enforcement of property rights when land values increase, when competition for land/ use of land increases, when exclusion becomes cheaper, or when common-use benefits diminish. As the process unfolds, tensions between different uses and among different users may arise and intensify. This may attract the state to supply and implement new property rights laws.

Definition of the Problem

The high contribution of agriculture to national economic production and domestic food self-sufficiency, and its role as the sole economic activity for the vast majority of developing countries' population, puts agriculture in a prominent position in policy discussions, and makes issues surrounding access to land and the use of land very topical among rural residents (most of them residing on communal lands, in the case of Zimbabwe). National governments would like output from the sector to increase in order to generate surpluses which can be used to finance industrial development; and to provide adequate food supplies for their rapidly growing populations. For rural residents, land is the single most important asset for generating livelihoods, a vehicle for investing, accumulating wealth, and for transferring it between generations (Deininger and Binswanger, 1999).

In Zimbabwe, for example, agriculture is the mainstay of the economy, providing the lion's share of formal (and informal) employment, foreign exchange earnings, and raw materials for domestic manufacturing industries. Agriculture directly employs about 30% of the country's work force as wage farm workers, while a sizeable proportion is

employed in industries linked to agriculture, such as fertiliser and farm equipment manufacturing, transportation and processing industries. In the communal lands where there are few wage employment opportunities, the vast majority of the people residing here can be thought of as earning their livelihoods in self-employment as peasant farmers. Agricultural exports, consisting mainly of tobacco, cotton, sugar, beef and horticultural products, provide over 50% of the country's foreign exchange earnings each year. While tobacco is by far the most important (in terms of foreign currency earnings) export commodity, the past decade has seen other activities such as the production of flowers for the European market grow in importance. Other commodities such as maize, wheat and milk are produced mainly for the domestic market and are inputs for a significant local processing industry.

The bulk of the marketed agricultural output (about 80%) is produced in the so-called large scale commercial (LSC) sector, one of the subsectors of Zimbabwe's dualistic agricultural sector (the second subsector is known as the communal sector). Only in the production and marketing of maize does the communal sector outstrip the large scale commercial sector. The production process in the LSC sector is relatively capital intensive and employs modern technology, although some activities remain very labour intensive (e.g. tobacco harvesting, curing and grading, cotton picking). Through the years the subsector has achieved high levels of productivity and efficiency and its products for the export markets are of high quality making some of them highly sought after in world markets.

While comparatively it would seem the LSC sector has performed much better than the communal sector, it should be noted that direct comparisons that do not take into account differences in resource endowment and resource quality between the subsectors can lead to misleading conclusions. Over 70% of the LSC sector farms are located in agriculturally favourable parts of the country (fertile soils and high rainfall). In contrast, 70% of communal land is located in marginal areas (poor soil fertility and low rainfall). Commercial farms have ready access to capital (accounting for over 80% of formal credit use), are highly capital intensive and use modern farming technologies and techniques, and are well serviced with such infrastructure as electricity, telephones, good roads, and railways. In the recent past a number of studies have, however, uncovered the inefficient

utilisation of land in the sector, with about 50% of the land being unused or underutilised (World Bank, 1991; Roth and Bruce 1994).

While total output from communal agriculture has increased substantially, and increases in productivity recorded, particularly in the period following independence in 1980, many communal areas still fall far short of their potential for all the major crops produced in the sector - maize, millet, sorghum, cotton, sunflower, and rapoko. Of greater concern is the high rate of soil erosion and resource degradation occurring in most of the communal areas that threaten to reverse the gains made in the past if nothing is done soon to combat these problems. To maintain the same level of production more fertiliser will have to be used to replace lost soil nutrients, and more agricultural land carved out of the already shrunken woodlands and forested lands. The deterioration of the land resource and the accompanying high production costs may curtail wealth accumulation efforts and keep households mired in poverty. Already, efforts to increase rural incomes and wealth levels are being constrained by the inadequacy of land for many households and lack of access for others. Bratton (1990) estimates the level of landlessness among communal lands households in Zimbabwe at between 6% and 12% in the late 1980s. Thus, for many households the scarcity of land and deterioration in its quality may limit or preclude opportunities to participate in production at the onset.

As outlined in this section, agriculture remains a very important economic activity in most developing countries including Zimbabwe, contributing a large proportion of total domestic output and food production, and providing an opportunity to earn income, to invest, and to accumulate wealth for a large number people. But as the development economics literature shows, strategies that are likely to succeed in increasing a country's per capita income level have to include plans for engendering growth in other sectors of the economy (e.g. manufacturing, services). Agriculture alone will not provide the solution. However, the formulation of measures to foster growth and transformation of agriculture will continue to be of critical importance for development and rural policies of many countries. In the past decade the economic literature, and associated policy discussions have focused on modernisation of land tenure systems, and the need to change land distribution patterns as a crucial measure to foster economic growth and to reduce poverty.

Land Tenure in the Communal Lands: Structure, Economic Consequences and the Pressure for Adaptation in the Communal Tenure System

Brief Review of the History of Zimbabwe's Communal Lands

Zimbabwe's communal lands cover 16.4 million hectares (about 42% of the country's total area, or 50% of the arable land), and are home to about 9 million people (about 70% of the country's population). About 74% of the communal land is located in the agriculturally marginal natural regions IV and V (Moyo et al 1991). The origins of the communal lands lay in the colonial policy of segregated land occupation. Following colonisation of the country in 1890, the colonial government set out to appropriate most of the agriculturally favourable land for white settlement, while the indigenous population was pushed onto poorer lands (first named native reserves and subsequently renamed tribal trust lands, and now communal lands) (Cheater, 1990). The Land Apportionment Act of 1931 legalised land segregation between Europeans and Africans, and designated 19.7 million hectares of land (60% of the total arable land) as "European land" (even though Europeans constituted less than 5% of the total population) on which Africans were barred from owning land.

In the European subsector, farmers were granted farmland under a freehold tenure system, in which titles to land were issued and recorded under the Deeds and Registries Act, and holders were assured perpetual ownership, rights to bequeath, and rights to transfer rights through rental or sale. The Survey Act required landowners to have their land surveyed and fixed boundaries established. The private property rights system of tenure that prevails in the large-scale commercial sector has been credited with providing positive incentives that have resulted in the attainment of a high degree of efficiency, and willingness to use the land sustainably.

At the time when native reserves were set up, it was envisaged that land use in the subsector would continue to be guided by the customary system of land tenure. Under the customary tenure system land is held in common by the group/ community and traditional authorities (chiefs and headman) were authorised to allocate specific plots of land to individuals/ households for temporary or permanent cultivation. Unallocated land is used in common for pasture and woodlands from which timber, wild plants and game

can be collected. Under customary tenure, the right to use of land may be inherited, and a person may exclude others from using his land during the cropping season but the land may revert to commons after the harvest for livestock to feed on the stubble. An individual's right to his/ her arable land is assured for as long as its use is in accordance with accepted practises and regulations, is continual (including the fallow period where this is the method used to renew soil fertility), or as long as the holder resides in the community. If land is not used for a period of time beyond the standard fallow period, the land may be considered to have been abandoned. It thus reverts to the community's pool of common land and available to anyone who might need to use it. The customary tenure system was in harmony with the socio-economic conditions existing at the time (relatively abundant land, production mainly geared towards subsistence, and strong social cohesion), and served the communities very well in resolving their resource management problems at the time.

With the creation of native reserves came various changes that were at variance with the conditions under which customary tenures evolved. For example, the reduction of the area under the control of each tribal group, and the establishment of rigid territorial boundaries, the emergence of markets for agricultural products, as well as changes in the roles of tribal leaders who in addition now functioned as representatives of the central government. It would be unrealistic to expect indigenous tenures to perform as well under such different conditions. Inevitably reports of serious land degradation and reduction in the productivity of "native agriculture" were surfacing by the 1940s. The seriousness of the problem can perhaps be seen from the government's determination to do something to resolve the problem. For example, the Land Husbandry Act was passed in 1950 through which attempts were made to abolish customary tenure and replace it with freehold tenure for arable, and a system of marketable permits for grazing rights.

Description of the Tenure System in the Communal Lands: Disturbances (Shocks) in the System

The Communal Lands Act of 1982 renamed the tribal trust lands communal lands and set to establish a communal tenure system based on elements of customary tenure as

the land tenure system that would guide land use in the subsector. The choice of communal tenure was based on the notion that it is more in line with the cultural history of the country. The egalitarian qualities of customary tenure were seen to be a marked contrast to the freehold tenure option which the post-colonial government perceived as capitalistic and an embodiment of western culture (i.e., undesirable) (Ranger, 1988; Cheater, 1990). A number of modifications were made to the customary tenure system as it existed at the time. Communal ownership of land gave way to state control as the title to all communal land was vested in the president, who was supposed to hold the land in trust for all communal lands residents. The authority of traditional leaders to allocate land was revoked (the second time this has happened, the first being in 1950 only to be restored in the Land Tenure Act (1969)) and assigned to district council. The traditional leaders maintained their customary roles as community leaders.

The district councils in turn delegated the authority to allocate land to elected committees at the village and ward level (Village and Ward Development Committees (VIDCO and WADCO, respectively)), whose responsibility was to implement district land use and management plans. The VIDCO's role was to allocate specific plots of land to individuals/ households for cultivation and the establishment of a residence. Once a person establishes their residence in the community, he or she automatically acquires the right to use common lands for grazing livestock and to collect wild plants.

The taking away of traditional leader's authority to allocate land ignited sustained resistance by both the traditional leaders and the general population. To minimise the tension between the two sets of village leaders, most villages simply incorporated the customary leaders into the new VIDCO structures (Sithole and Bradley, 1995). However, as pressure continued to mount over the years, and with communities finding ways to circumvent government policy, in 1997 the government restored back the authority to allocate land to chiefs, headmen and *masabhuku* (kraal-heads). The district councils are still responsible for coming up with land use and management plans.

While organisations or "the teams playing the game" are important in influencing incentives and economic behaviour, institutions defined in the sense of rules (North, 1990), have perhaps an even more critical effect on the behaviour of individual resource owners. Under communal tenure, households have the right to grow crops for subsistence

use and for sale, and in many instances to plant trees. In general, the right to use land also includes the right to transform it, for example, by constructing contour ridges and other soil conservation structures, as well as other structures that may enhance the productivity of the land. Whether or not in the end the landholder invests the money and effort required to undertake such improvements will depend on the presence of other rights in his/ her bundle of rights. These additional rights should allow a landholder to capture the benefits produced by the investment and to prevent others (including the government) from engaging in actions that may interfere with his/ her enjoyment of the benefits, or negatively affect the amount of benefits produced by the investment.

A landholder in the communal lands may exclude others from his/ her land during the cropping season, but land reverts to the commons (except in irrigation schemes where cropping takes place all year round) for livestock to feed on stubble after the harvest. The limit in the degree of exclusivity discourages intensive use of the land as it discourages activities such as the planting of trees, tree crops and other permanent crops in agricultural fields because it is difficult to care for them when livestock are allowed to roam the fields. Households cannot take advantage of their crop stubble to provide livestock feed (unless they have sufficient labour and means of transportation to cart it to the homestead) at critical times during the dry season. Lack of resources for supplementary feeding is a major reason for poor livestock productivity in the communal areas.

There are other overlapping rights, for example, even during the cropping season. A landholder may not exclude others from collecting indigenous fruit or wild plants when there is no evidence of damage caused to crops. Some resource poor households in rural areas rely heavily on such resources. Thus it may be important that these communal rights be protected. However, increasingly many households in communal areas are fencing-off their fields in order to take advantage of crop stubble for intensive livestock production, and to enable them to undertake land improvements that otherwise cannot be undertaken if the land remains accessible to all in the village.

Land rights to agricultural land may be bequeathed to heirs, gifted to other members of the community, or rented out, but the sale of land is explicitly prohibited by the Communal Lands Act. While prohibiting land sales may help to discourage land

concentration, and promote equity, restrictions on land transfers may impede the flow of land from inefficient users to more efficient users. The mobility of economic agents in search of other economic opportunities in the economy may also be impeded if land rights are tied to physical presence on the land, leading to an inefficient allocation of resources. For example, a household with a comparative advantage in the sale of labour services in the wage markets of urban centres, may need to keep some members on the land to maintain its claim if the household cannot recoup the value of the land through selling or renting. As the rural population has become more mobile many households do sell their land (under the guise of selling improvements to the land, a practise that is accepted under customary tenure) when they decide to move to towns or other parts of the country.

Under customary tenure, a person applying for land may offer the *sabhuku*/ headman a small fee (e.g. a chicken) in appreciation of his or her taking time to "show" the applicant where he can establish his field. Over time as the authorities responsible for allocating land realise how valuable land has become to households, fees for land allocation are no longer a simple matter of customary obligation but a requirement. Most headmen and *masabhuku* have taken to setting the fee for land allocation at high rates in an attempt to capture part of the economic rent associated with land; this rent has increased significantly owing to the increasing scarcity of land (Bourdillon, 1982). Such a development is often accompanied by corruption, as outsiders who can offer more money can get preference for land allocation over poor locals, and those close to the authorities stand a better chance of being allocated land (Mukamuri, 1991). There are reports in other communal areas where village leaders have been known to evict members of the community for seemingly minor offences against some customary regulation, or rescind their land allocations. The land that becomes available as a result is reallocated to people who can pay the highest land allocation fees or those with connections to the authorities.

As scarcity has enhanced the value of the land, the communal tenure system is placing too great a strain on the public spirit of the authorities charged with its allocation (FAO, 1962). This and other developments have the effect of greatly undermining the perception of tenure security of many communal lands households.

Continuous use of the land and observance of standard customary regulations regarding its use, or continued residence in the community, provided assurance to a person's claim to his land under customary tenure. The transfer of ownership of the land from the communities to the state has created a sense whereby communal households feel their right to land depends on the will of the government. As a result landholders are less certain of their ability to maintain their claim to the land. In some communal areas households have lost their land to "development projects" without receiving adequate compensation for it.

The foregoing discussion identifies some important attributes of communal land tenure and their link to the economic behaviour of individuals/ households, and the performance of individual, the household or village economy. The discussion also reveals where and why there is dysfunction between communal tenure and individual decisions which would result in efficiency losses, and impede efforts by right holders from maximising the value of their resources. The dysfunction generates on one hand negative incentives with regards to resource use, and signals demand for institutional change on the other hand. The literature points to changes in land values as the major determinant of institutional change. The following section investigates the determinants of land values in rural communities and uses examples from the communal areas in Zimbabwe as empirical evidence.

Factors Disrupting the Communal Tenure System and the Pressure Toward Individualisation of Land Rights

As the population grows and the money economy develops in importance, the relative abundance of land tends to decrease. The commercialisation of agriculture occasioned by urbanisation and improvements in transportation and communications has had a profound influence on land by increasing its economic value. Introduction of cash crops, for example, tobacco, sunflowers and cotton, increases land values. The emergence of the urban market for food provides an incentive for farmers to expand production of food crops such as maize, sorghum and millet beyond subsistence needs. The incentive to

produce for the market is reinforced by the availability of consumer goods on which the cash earned can be spent.

The creation of the colonial state (by the British South African Company in 1890) eliminated inter-tribal wars, bringing peace and stability, and introduced health services, factors that favoured growth of the indigenous population. At the same time appropriation of a large part of the land for white settlement greatly reduced the amount of land available, and good agricultural land quickly became scarce.

By the early 1900s, farmers in the native reserves were producing significant quantities of maize, tobacco and cotton and found ready markets for their products in the emerging towns and mining settlements (Ranger, 1985). Farmers used their earnings to purchase consumer goods such as sugar, cloth and manufactured clothing; durable goods (e.g. household utensils); and farm equipment. The flexibility of the customary tenure system allowed farmers to take advantage of the new economic opportunities and to expand the cultivated area for those who had access to sufficient labour resources. But the land tenure system failed to provide sufficient incentives to encourage sustainable use of the land as indicated by reports that suggest that high rates of soil erosion became a critical problem by the 1940s.

In more recent times technical change and positive development and rural policies have contributed to further increases in land values. Technical change can be described as the enlargement of the set of efficient technologies available to production units in the economy (Gomulka, 1990). Two paths to achieving technical change are considered in the literature. Traditional (neo-classical) economic theory takes technical change as being exogenous to the economic system - a result of autonomous developments in science and technology. An alternative theoretical approach, the theory of induced innovation, emphasises the role of choices made by economic agents in response to constraints imposed by endowments or to opportunities presented by growth in demand as sources of technical change (Hicks, 1939; Griliches, 1957; Hayami and Ruttan, 1985). Regardless of the path to technical change, a technological innovation can facilitate the substitution of relatively abundant (hence cheap) for relatively scarce (hence expensive) factors in the economy (Hayami and Ruttan, 1985; Goel, 1999). For example, farmers may use high yielding seed varieties (which have to be used with fertilisers if their full potential is to

exploited) which facilitates the use of fertilisers to substitute for land. Improvements in agricultural implements allow the substitution of land and capital for labour. New inputs such as new seeds and new husbandry practises can be catalysts for technical change as they encourage the substitution of relatively cheap for relatively expensive factors (Hayami and Ruttan, 1985).

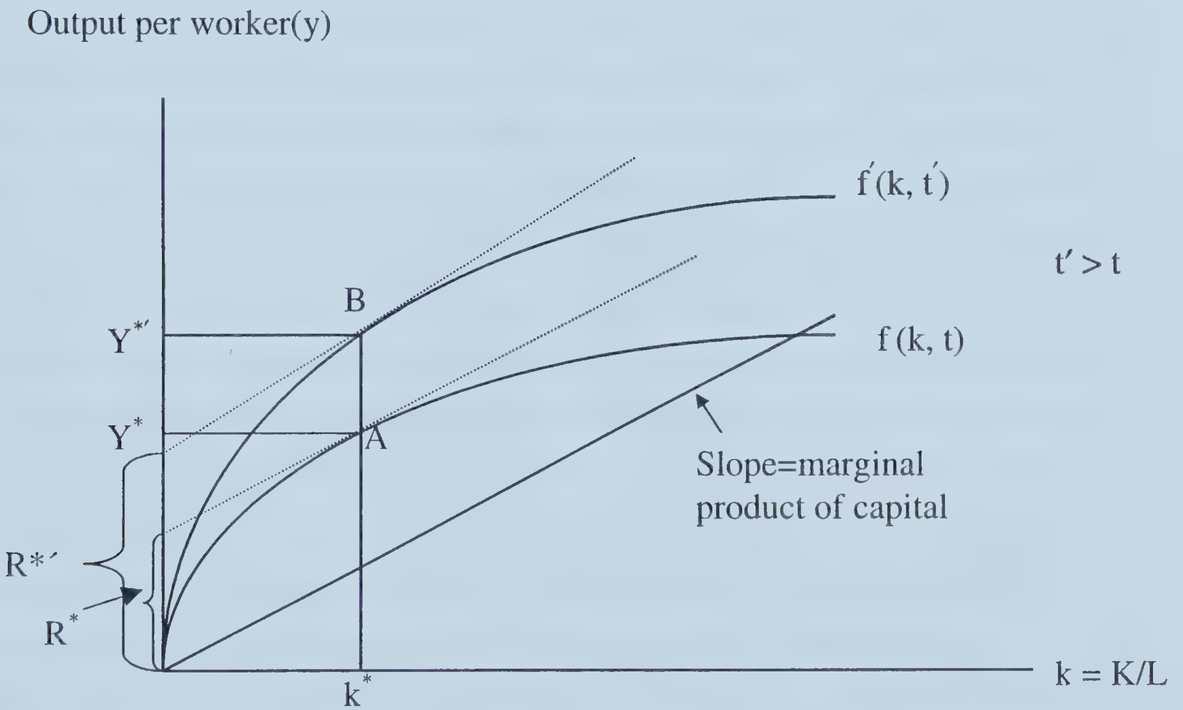
Fertiliser may increase total output and the productivity of the land, thus increasing the economic rent attributable to the land. The new technologies provided by technical change allow more output per unit of input than was possible with old technology. This can be illustrated by a closer examination of a stylised production process for a representative production unit/ farm.

Suppose a farm firm produces in a constant-returns-to-scale economy using the technology represented by the production function (in "intensive" form – in which each variable is expressed in per-unit–of-labour form): $\mathbf{y = f(k, t)}$,where y is output per worker and **k** is a composite input (**K/L**), the capital (**K**) to labour (**L**) ratio, and **t** represents the technology. The input **k** is used in combination with other inputs, for example, land. When land is scarce or if the amount of land available to the household is fixed, it is not a choice variable in the household's optimisation problem. The household's production technique can be represented graphically as shown in Figure 4-1. Under the existing technology, $\mathbf{k}^*$ is the profit maximising equilibrium. This level of production under the current state of technology (method of production), is associated with a level of economic surplus denoted by $\mathbf{R}^*$. When technical change takes place the production function shifts outwards to $\mathbf{y' = f'(k, t')}$. This means that with a given number of units of inputs (or capital units per worker), more output can be produced than was the case before.

Suppose the technical change is Hicks-neutral, which means the marginal rate of substitution between capital and labour is constant. The effect of the technological change on output is Hicksian, meaning output will grow along the path **AB**. The amount of total output produced is $\mathbf{Y}^{*'}$. This level of output with the new technology is associated with an increase in the level of economic surplus $\mathbf{R}^{*'}$. Part of the economic surplus is captured by landholders in the form of higher rental rates for land (to reflect its increased productivity), while some of it may be transmitted to consumers of agricultural products through lower product prices. Some of the surplus may accrue to the suppliers of

agricultural inputs as a result of increased input demand. Land, which is a fixed factor, is the residual claimant of any economic surplus that is not captured by landholders (in the form of land rentals), technology generating firms, or consumers (residual value is bid into economic rent associated with the land). Thus, technical change may increase land values and provide incentives for changes in property rights.

Figure 4-1: The effect of technical change on output and the amount of rent produced by land.



Source: Adapted from Gomulka (1990)

The input-output coefficients of a production process depend not only on its purely technological content, but also on the human and physical environment in which the process is operated (Gomulka, 1990). Changes in this environment without technological change proper, may shift the production function. The input-output coefficients of the same production process will be different for economies with different levels of education, and access to health care. The size of the market is also important,

since processes that may be inefficient when the market is small can become efficient with increased market density.

Although it is difficult in practice to separate out a shift caused by environmental factors from a shift due to technical change proper, the factors underlying the changes are clearly qualitatively different. Thus, it may be useful for analytical purposes, if not practical, to maintain the distinction.

Since the 1950s agricultural production in Zimbabwe has benefited from the developments in hybrid seed production, and developments in pest and plant disease control. Zimbabwe released its first hybrid maize seed in 1949, the second country to do so after the USA. More hybrid maize seed varieties were produced in subsequent years, with attention turned toward varieties more suited to conditions in the communal areas (shorter growing season and relatively lower moisture requirements). To this end the variety R201 was released in 1970, and since then more have been produced. Improved tobacco, wheat and cotton seed varieties were also developed during the same period. In the period between 1925 and 1965 most cotton insects and diseases had been successfully combated. Other changes include the improvements in farm implements and machinery; for example, the ox-drawn plough and cultivator became available to communal farmers.

In addition there were some improvements in inputs already in use as well as increases in the use of some factors as they became more accessible due to improvements in transportation. The expansion of the agricultural extension system improved the farming knowledge of many communal farmers, thus improving the quality and productivity of the labour input. That schooling or education levels lead to increases in agricultural production has long been established in the literature (Evenson, 1982; Griliches, 1988). Increases in the level of input use, although it may not qualify as technical change, leads to increases in production if inputs were previously not used in optimal amounts. Efficient allocation of resource assures the generation of optimum economic surplus from resources.

The technical change, combined with positive development and rural policies of the 1980s (development of market, transportation, and communications infrastructure in the communal areas; and provision of health, education) (Rukuni and Eicher, 1994), are major sources of growth in production and productivity that has occurred in communal

lands agriculture. For example, between 1979 and 1989 total maize production in the communal areas grew at an annual rate of 9% (part of the growth is due to expansion in area planted to the crop) while productivity grew by 6.7% annually. Communal lands cotton production grew at 26.5% per annum and productivity by 1.3%. The productivity of other crops has similarly increased in the same period: 2.7% for groundnuts, and 1.1% for sorghum. The communal lands share of marketed maize output grew from less than 25% in the 1970s to about 80% in by 1989 (Roth and Bruce, 1994).

As agricultural production and productivity increase, and the demand for agricultural products increases, the scarcity value of land value increases. Higher land values increase the benefits to be derived from more precise and secure land rights (Feder and Feeny, 1993). Changes in the socio-economic conditions also increase the set of potentially profitable investments and transactions, which may require landholders to expend money and other resources to be able to take advantage of the opportunities. Such opportunities may remain unexploited if a resource owner is liable to see the benefits produced by his investment seized by others. Besley (1995) argues that that secure rights may increase the returns of an investment by reducing the probability of asset expropriation (or the benefits flowing from it) may provide an incentive for a landholder to actively seek to enhance his rights. The active pursuit of rights has also been discussed in the theoretical literature by de Meza and Gould (1992) who argue that actions to secure rights will follow concerns about insecurity of the individual's rights over resources.

The possibility of using land as collateral, enabling the landholder to obtain credit at a lower interest rate can also provide a motive for a landholder to engage in activities that will secure his/ her rights (Feder, et al 1988; Besley, 1995). Also, better land rights can lower transactions costs and thus increase the proportion of the value of land that can be captured by a landholder if land is rented or sold. Well-defined property rights can lead to an increase in the size and competitiveness of the market (Johnson, 1972), thus benefiting landholders. For example, unrestricted transferability allows for land to be sold or rented not just among member of the same community, but to outsiders as well.

Investments may provide a way for landholders to enhance their land rights (other alternatives such as acquisition of a land title, are not available to communal households at the moment). It has been argued that land rights may depend in part on past

investment. Bruce (1988) presents the argument that tree planting can allow the landholder to secure his/ her claim to the land. By taking advantage of the customary rule that says land under crops may not be reallocated, holders of temporary or fragile titles, who succeed in planting trees can enhance their tenure. Levin (1976) reports that among farmers in Cameroon, a major reason for planting cocoa and coffee is to retain undisturbed possession of the land so long as the trees survive. Similar behaviour is reported by Koby (1979) among farmers in Cote de"Ivoire and Zanzibar. Planting trees has also been used by some farmers as a way to claim/ appropriate land from the commons (Bruce and Noronha, 1985).

A Theoretical Model of Endogenous Land Rights

Very few attempts have been made at formally modeling institutional change (Feder and Feeny, 1991; 1993; Besley 1995 are exceptions). Social institutions are necessarily complex, with numerous interrelated variables that are difficult to capture in a simple modeling effort. However, even some greatly simplified models may help clarify the existing theories of institutional change, enabling further refinements, and ensuring consistency between assumptions and conclusions.

In this section a formal model of endogenous land rights is presented following that developed by Besley (1995). The model captures some of the main arguments presented in the preceding sections and can be applied to the communal areas in Zimbabwe. The predictions of the model provide the basis for the empirical study, described in the subsequent section that explores the determinants of the land rights enjoyed by households in the communal areas in Zimbabwe.

Unlike other studies of land tenures that treat land tenures as being determined outside the economic system, the model considers land tenure is an endogenous variable. It can be argued that the level of control achieved by a landholder over his/ her land and the benefits/ services it provides, has a large internal element, which the landholder approaches like any other decision, that is, the degree of control is determined at the margin by the level of costs and benefits. The implication is that, farmers choose the

optimal bundle of rights to include in their land ownership right, and the degree to which these rights are specified.

Suppose a farmer decides at time t how much capital, denoted by k_t, to invest on his field. The investment generates a return π at time $t+1$, and depends on the farmer's land rights R_{t+1} at the time. The returns function is denoted as $\pi(k_t, R_{t+1})$. The cost of the investment is denoted by c (k_t, R_{t+1}). Under the hypothesis of endogenous property rights, an investment of k_t can influence the farmer's future land rights (R_{t+1}), thus

$$R_{t+1}.= f(\phi k_t, R_t) \tag{1}$$

where ϕ is variable that takes a value of 1, if landholders are able to influence their property rights and 0 otherwise. When investments can alter a landholder's property rights, the returns and cost functions associated with the farmer's investment can be rewritten thus, $\pi\ (k_t, f(\phi k_t, R_t))$ and $c(k_t, f(\phi k_t, R_t)$. The wealth maximising investment choice for the farmer can be obtained by solving the problem:

$$\underset{k_t}{Max}\, W(k_t, f(\phi k_t, R_t)) = V(k_t, f(\phi k_t, R_t)) - c(k_t, f(\phi k_t, R_t)) \tag{2}$$

The solution for k_t is given by the first order condition (if there exists an interior solution to the problem):

$$W_k\ (k_t, f(\phi k_t, R_t)) + W_R\ (k_t, f(\phi k_t, R_t))\phi f_k(\phi k_t, R_t) = 0 \tag{3}$$

Equation 3 shows that incentive to invest derives from the marginal productivity of capital in the production of the physical good and in the improvement to the farmer's land rights. The desire to force capture of the value of land (increased by technical change, population growth and increased demand for agricultural output), provides a motive for the landholder's pursuit of rights in resources.

Applying the Model to the Communal Lands in Zimbabwe

Description of Study Areas

The data used in this study was collected during household surveys conducted in Mangwende Communal Land in Murehwa District and Chivi Communal Land in Chivi District. Mangwende is situated about 80km northeast of Harare in Mashonaland East province, and Chivi is in southern Zimbabwe in Masvingo province, 60 kilometres south of the town of Masvingo (the provincial capital). A map of Zimbabwe in Appendix (**III**) shows the relative location of the study sites.

In Mangwede the survey site is Mukarakate East Ward (Ward 20), 30 kilometres to the east of Murehwa Centre, the district's administrative centre. Murehwa Centre provides a wide range of services for inhabitants of the surrounding area. There is a collection of small locally owned shops and a number of branches of the big chain-stores from Harare, doctors' and lawyers' offices, drugstores, a regional hospital, a police station, branches of two major national banks, a hotel and conference centre, and several schools. The shops carry a wide range of goods including groceries, clothing, farming and construction goods and equipment. A number of government departments have their provincial headquarters at Murehwa Centre including the Department of Agricultural and Technical and Extension Services (AGRITEX), Veterinary Services, and the Agricultural Finance Corporation (AFC). It is also the site for a Grain Marketing Board (GMB) depot (marketing centre) and the location for grain silos (one of 8 sites countrywide) for the storage of the country's strategic grain reserves.

Takawira Ward (Ward 14) is the other survey site, located 30 kilometres south of Chivi Centre. Chivi Centre, the administrative and service centre for Chivi District is much less urban and by far smaller than Murehwa Centre. Besides the District Council offices, there are district offices for the departments of Veterinary Services and AGRITEX, a police station, and a district hospital (construction of which had just been completed at the time of the surveys). Unlike Murehwa Centre, Chivi Centre does not have private medical and legal services, and has only a few, small locally owned shops. The goods sold in the shops range from groceries, clothing and farm inputs and

equipment. The GMB depot at Chivi is operational only during the crop marketing season.

Besides being an administrative and service centres, both Murehwa Centre and Chivi Centre have residential sections that have been growing since the mid-1980s. The growth followed changes in government policy that granted the authority to allocate residential plots to rural district councils at those rural service centres which the councils deemed to have the potential to expand and attract a significant population around them. Such centres were designated as "growth points", and the land around them was surveyed and plans for development drawn, followed by the provision of piped water and electricity. The centres were also targeted to be sites for regional government offices. To encourage further development it was planned to issue titles to land for owners of properties at such centres.

Mangwende and Chivi districts differ markedly in their agricultural potential and population density. Mangwende is situated in the more agriculturally favourable natural region II, with high rainfall (average 800mm per annum) and relatively fertile soils. Murehwa district is one of the country's main maize producing areas. In addition, groundnuts, sunflower and cotton are widely grown. On the other hand, Chivi is one of the most arid areas in Zimbabwe (located in natural region V), with annual rainfall below 500 mm, and is subject to frequent droughts. The soils in the district are largely infertile and sandy. Only drought-tolerant crops such as sorghum and millets can be grown here with some measure of success without irrigation, although most farmers will still try to grow maize because it is the preferred staple grain. Besides crop agriculture, farmers in both regions keep a variety of livestock, including cattle, goats, sheep, donkeys and chickens. Cattle are important because they provide a number of services and products, such as draught power, milk, manure, and occasionally an animal is slaughtered for meat. Cattle, as well as other livestock, may also be sold to provide cash in times of emergencies; for example, when a household needs to pay for school fees, purchase food, or to meet medical expenses.

According to the results of the surveys, the average population density in ward 20 in Mangwende is 103 persons per square kilometre whilst the comparable statistic for ward 14 Chivi is 64 persons per square kilometre. The average household size in

Mangwende is 6.4 persons and in Chivi it is 7.3. The characteristics of the two regions are summarised in Table 4-1.

Table 4-1: Agro-ecological and socio-economic characteristics of Chivi and Mangwende Communal Lands.

	Mangwende	Chivi
Average annual rainfall	800mm (between Nov. and March)	450 mm (most of it received between December and March)
Vegetation type	Miombo woodlands	Mopane woodlands
Soil type and quality	Sandy loams Relatively fertile	Sandy
Population density	103 persons per square kilometre	64 persons per square kilometre
Average household size	6.4 persons per household	7.3 persons per household

The Survey

The data for the study was collected during household surveys conducted over the period July and October 1997. A total of 618 households, 390 in Mangwende and 228 Chivi, were interviewed and data on household size, production activities, and perceptions about tenure security were gathered. The samples were drawn from a list of all households in each of the wards, created before the start of the surveys. There were 908 households residing in ward 20 in Mangwende, and 696 households were resident in ward 14 in Chivi at the time of the surveys. The households in the sample were those which had an adult member (eighteen years or older) at home when an interviewer visited the household, and were willing to be interviewed. No cases of households refusing to be interviewed because they had objections to either the process or the subject matter addressed in the interviews were reported. In general, most households were very co-operative and expressed interest in the issue of land tenure.

The interviews were carried out by the author aided by a team of eight research assistants from the survey communities (four from each ward). Additional information was collected from secondary sources (e.g. AGRITEX reports and other government documents), and from interviews with key informants like the local government officials and agricultural extension workers and ward councillors and village headmen. In order to

gain the trust and co-operation of households during the surveys, ward councillors were asked to inform households at village and ward meetings about the impending surveys.

The research assistants (two males and two females in each site) received some training (over a period of one week) before they were deployed to conduct the surveys. The training consisted of familiarisation with the objectives of the research and the survey instrument (questionnaire), survey etiquette, and pre-testing of the questionnaire. A Shona (the local language) version of the questionnaire was used for the surveys.

The Data

Table 4-2 summarises the characteristics of the sample. The average farm size in the two regions is comparable to the national average for communal areas, which is 3 hectares per household. The average farm size in Mangwende is about 20% smaller than the average farm size for the Chivi sub-sample, probably a reflection of the differences in population density in the two regions.

Judging by cattle ownership, with an average herd size of 4.26 animals, farmers in Mangwende are wealthier than those in Chivi who on average own 2.29 head of cattle. The difference in cattle ownership may be explained in part by higher income (crop income) in Mangwende providing households with more resources with which to facilitate investment in a lumpy asset, such as cattle. In 1997, at the time of the surveys, the price for a head of cattle was about Z$2,000 (approx. CDN$300), which is the equivalent of a third of the annual value of crop income for an average household. The ability to afford investment in cattle is an important issue, since at the time of the survey many households (particularly in Chivi) were trying to rebuild their herds following droughts in 1992 and 1995 when many animals died or were sold in order to buy food.

Fewer people in Mangwende are related to the village *sabhuku* (65%) or the VIDCO leader (49%) compared to Chivi, where the proportions are 86% and 63%, respectively, suggesting a higher intermix of different people in Mangwende. This intermix results in an increase in the number of impersonal transactions which may lead to an increase in transactions costs for gathering information and enforcing contracts during the exchange of goods among households. On average, households in Chivi have

been in their current location longer compared to the households in Mangwende. A longer period of residence may be suggestive of more stable, cohesive social relations which may help lower transactions costs.

Table 4-2: Household characteristics (means)

	Aggregate	Mangwende	Chivi
Age of household head[a]	45	45	45
Formal education of head (years)[a]	7	7	7
Size of main farm (hectares)	3.02 (2.72)	2.81 (3.01)	3.39 (2.10)
Number of years resident in village	25.17 (17.22)	23.21 (13. 86)	28.54 (21.42)
Number of cattle	3.53 (4.68)	4.26 (4.85)	2.29 (4.10)
Household size	6.19 (2.80)	6.20 (2.60)	6.16 (3.11)
Number of adult females	1.54 (1.11)	1.43 (1.00)	1.79 (1.24)
Number of adult males	1.47 (0.92)	1.37 (0.86)	1.63 (0.99)
Proportion own a plough	.72	.71	.73
Proportion related to *sabhuku*	.73	.65	.86
Proportion related to VIDCO chair	.54	.49	.63
Proportion migrants	.21	.18	.25
Number of observations (N)	618	390	228

[a] Median

Communal tenure grants the household use rights, as well as limited rights to exclude and to transfer land. Alienation of the land to outsiders is particularly prohibited. However, with population increases and increased scarcity values for land, pressure is mounting for modification of communal land tenure system towards more individualistic rights, granting the ability to transfer land without needing approval from the community. The demand for transferable land rights is reflected at the household level by an increasing number of informal land sales that already take place in many communal areas but are unacknowledged by the authorities. Farmers were asked about the transfer rights - decomposed into rights to sell, rent, bequeath, pledge, mortgage, and gift – associated with agricultural land, including whether or not approval by traditional authorities was required to exercise these rights. Thus, there were 12 categorical variables describing the transfer rights. A farmer may not consider all these rights at the same time when making investment decisions, not even when such rights are assured through possession of a land title. As well, transfer rights in this case are self-reported rights, but asking about the presence or absence of each right provides an opportunity to find the type of rights that appear to be important to the farmer.

The type of rights enjoyed by farmers, the investments in land (tenure securing activities), and other field characteristics are summarised in Table 4-3. About 40% of the respondents in each region indicated they could sell their land but only with approval of the traditional authorities. This may be reflective of the fact that customary tenure allows landholders to ask for compensation for improvements on the land when it changes hands. In most cases the compensation received is much higher than the value of the improvements, and it is clear to the farmers and the village leaders that what is really being paid for is the land. A large proportion of the households enjoy the right to bequeath land to heirs, although it seems in Chivi the approval of village authorities has to be sought first. This difference may be as a result of Chivi still retaining more traditional influences than in Mangwende.

More households (over 70%) in Chivi reported the ability to rent out land than in Mangwende, where the proportion is 38%. Discussions with farmers in Mangwende revealed that rental arrangements often ended in disputes, thus posing a risk to landholders. The high demand for land, in the face of severe land shortage and ill-defined land rights may be the source of an increase in the likelihood of false claims as households without land have an incentive to intensify their efforts to gain some land. Thus, lack of well-defined land rights may end up precluding the use of a land rental market as a vehicle for providing access to land for those who need to use it. In both regions many farmers reported that land may be given away as a gift to others.

Farmers were also asked about their perception regarding the security of their land rights. The concept of tenure security is here operationalised in the way of the risk (probability) of losing land. In the communal areas land rights are likely to be lost through disputes with other households, and as a result of expropriation by the traditional authorities or by the government. The majority of households in Chivi (58%) felt their land rights were quite secure a feeling shared by only 45% of the households in Mangwende. About 53% of the households in Mangwende felt there was a possibility that they may lose some of their land in the future, while 34% of the households in Chivi perceived of any risks to their claim to the land.

The survey also investigated farmers' decisions to undertake investments. The investments commonly available to farmers are in the form of improvements to the land:

construction of contour ridges, planting trees, adding manure to the land, de-stumping the land, building fences around the field, digging water wells, and constructing tied-ridges (for moisture conservation). The survey asked landholders about the improvements made on the land since they acquired it. All categories of land improvements were undertaken by a significant proportion of the households in Mangwende, while farmers in Chivi counted mainly building countour ridges, adding manure to the soil, and de-stumping the land as the most likely improvement to their land.

The major vehicle for accessing land is allocation by traditional authorities in both area, although a significant proportion of the households in Mangwende acquired access via inheritance.

Table 4-3: Land rights enjoyed (perceived) by households and land improvements. (numbers indicate proportions of households)

	Both Regions (N = 618)	Mangwende (N = 390)	Chivi (N = 228)
Rights[a]			
Sell without approval	.06	.04	.14
Sell with approval	.42	.42	.41
Rent without approval	.23	.20	.29
Rent with approval	.28	.18	.44
Mortgage without approval	.14	.17	.07
Mortgage with approval	.27	.30	.22
Pledge without approval	.07	.08	.04
Pledge with approval	.27	.36	.11
Bequeath without approval	.57	.73	.29
Bequeath with approval	.33	.27	.44
Gift without approval	.23	.18	.34
Gift with approval	.40	.37	.44
Mode of land acquisition			
Allocated	.60	.52	.75
Inherited	.31	.36	.22
Gifted	.05	.07	.03
Purchased	.03	.04	0
Appropriated	0	0	0
New Improvements/ Investments			
Contour ridges			
Planted trees	.69	.61	.82
Fencing	.40	.62	.03
Continuous manuring	.33	.34	.32
Well	.55	.58	.49
De-stumped	.22	.26	.10
Tied-Ridges	.47	.45	.49
Existing Improvements/	.51	.74	.11
Investments			
Contour ridges			
Planted trees	.35	.35	.35
Fencing	.08	.12	0
Continuous manuring	.03	.04	.02
Well	.11	.09	.15
De-stumped	.02	.02	.03
Perception of Security	.35	.45	.18
Unlikely to lose any land			
Likely to lose some land	.50	.45	.58
Very likely could lose some land	.46	.53	.34
	.04	.02	.08

[a] Recall that there is also a third category for each right, where rights are absent. This category is not shown, but may be derived by subtracting the two proportions presented from 1.0.

Empirical Models

This section presents some equations that may be used to test whether the idea that investments may be used to alter landholders' rights is empirically important. The

theoretical model outlined in the previous section suggests estimating an equation of land rights enjoyed by household *i* at time *t+1* on agricultural land on which an investment of k_{it} was made at time period *t*, with land characteristics x_{it} and household characteristics h_{it} as explanatory variables. This can be written as:

$$R_{it+1} = f(k_{it}, h_{it}, x_{it}, R_{it}) \tag{4}$$

The theoretical framework also suggests an alternative specification of the investment function compared to the standard investment demand equation used in most studies of land tenures (Feder and Onchan, 1987; Feder, et al, 1988; Place and Hazell, 1993). These previous models are based on the assumption that farmers only considered narrowly defined investment costs and benefits. The model presented here suggests that farmers also consider the costs and benefits associated with potential changes in land rights resulting from an investment. An equation for investment on agricultural land, owned by farmer *i* at time *t*, with land rights R_{i1+t}, land characteristics x_{it}, and household characteristics h_{it} as explanatory variables may be specified. The equation can be written thus:

$$k_{it} = g(R_{it+1}, h_{it}, x_{it}) \tag{5}$$

Since the last improvements on the land may be made well before the survey was conducted and the rights are those reported at the time of the survey, the data are assumed to correspond to investment at time *t* (k_t), and the rights reflected the impact of the investment (R_{t+1}), as discussed above in the theoretical model.

First, an investigation of the transfer rights enjoyed by farmers is carried out including the determinants of the rights. The survey asked farmers if they enjoyed a particular right and whether or not they need approval to exercise the right of the village authorities. The data on rights are thus presented as discrete and ordinal (three levels/ ranks) indicating either the absence of a right, requirement of community sanction to exercise a right, or the presence of unfettered rights. Applying the ordinary least regression (OLS) technique in a model for explaining the determinants of the rights

enjoyed by a landholder generates the linear probability model. The linear probability model has several shortcomings in this case (e.g. estimated parameters are inefficient, it violates OLS assumption about the distribution of the error term, and estimated probabilities may lie outside the limits (0,1) (Maddala, 1983; Greene, 1995). Logit and probit models are not suitable for estimating the model either. A logit or probit model does not take into account the fact that the dependent variable represents ranks/ categories, resulting in loss of some information. An ordered probit/ logit approach is chosen instead to estimate the model. Ordered probit/ logit models are built around a latent regression model:

$$y_i^* = \beta' Z_i + \varepsilon_i$$

where Z_i is a vector of household and land characteristics for individual i, β is a vector of unknown parameters to be estimated, ε_i is a random error term and y_i^* is an unobservable variable, such that:

$y_i = 0$ if $y_i^* \leq 0$ (i.e., y falls in the 0 category if the condition $y_i^* \leq 0$ holds)

$y_i = 1$ if $0 \leq y_i^* < \mu_1$

$y_i = 2$ if $\mu_1 \leq y_i^* < \mu_2$

y_i is the ordinal observable counterpart of y_i^* and the μs are unknown parameters to be estimated together with βs[1]. In the data there are 3 possible responses for each observation: the farmer does not enjoy the right, requires approval to exercise the right or enjoys right without having to seek approval first. The ordered probit/ logit model estimates the probability of the response falling in one of the 3 categories thus:

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[1] For model estimation one of the μs is normailised, for example, $\mu_2 = 0$ (in the case of 3 cells), and there is no need for μ_2 since probabilities sum to 1 (Greene 1995)

$$\text{Prob}(y_i = 0) = \phi(-\beta' Z_i)$$

$$\text{Prob}(y_i = 1) = \phi(\mu_1 - \beta' Z_i) - \phi(-\beta' Z_i)$$

$$\text{Prob}(y_i = 2) = \phi(\mu_2 - \beta' Z_i) - \phi(\mu_1 - \beta' Z_i)$$

where Z_i is a vector of household and land characteristics for farmer i. Assuming a normal (logistic) distribution of the error term (ε), the model can be estimated as an ordered probit (logistic[2,3]).The ordered probit model is estimated using maximum likelihood methods and the likelihood function in the case of **n** individuals and **m** ranks is given by:

$$LF = \prod_{i=1}^{n}\prod_{j=1}^{m}[\phi(\mu_j - \beta' Z_i) - \phi(\mu_{j-1} - \beta' Z_i)]^{\gamma_{ij}}$$

where $\gamma_{ij} = 1$ if y falls in jth category or $\gamma_{ij} = 0$ otherwise [i = 1,2, ...,n; j = 0, 1, 2, ..., m], which implies that $\text{Prob}(\gamma_{ij} = 1) = \phi(\mu_j - \beta' Z_i) - \phi(\mu_{j-1} - \beta' Z_i)$, a generalised form of equation 3 (Maddala,1983).

The estimated coefficients of the ordered probit model have a different interpretation from the ones obtained from an ordinary linear regression model. The sign on the estimated coefficients tells us the direction of the effects of a change in covariates on the dependent variable, and the standard errors can be used to test the significance of the explanatory variables. However, the magnitude of the coefficients cannot be interpreted explicitly as weights or marginal changes in the dependent variable due to a change in the explanatory variables. Instead, for continuous explanatory variables, the marginal effect on the dependent variable as a result of a small change in one of the explanatory variables (holding β and μ constant) on the probabilities in each cell can be calculated as:

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[2] The function for the logistic distribution is $F(V) = e^V / (1 + e^V)$ where V is a function of the respondent's characteristics.

[3] The logit and probit models do not lead to appreciable differences in the values of the estimated parameters (Maddala 1983; Greene 1995).

$$\frac{\partial Prob[y=0]}{\partial Z_i} = -\varphi(\beta'\overline{Z})\beta_i,$$

$$\frac{\partial Prob[y=1]}{\partial Z_i} = (\varphi(-\beta'\overline{Z}) - \phi(\mu - \beta'\overline{Z}))\beta_i,$$

$$\frac{\partial Prob[y=2]}{\partial Z_i} = \varphi(\mu - \beta'\overline{Z}))\beta_i,$$

where φ (.) is the standard normal probability density function evaluated at $\beta'\ \overline{Z}$ and μ-$\beta'\ \overline{Z}$, and $\overline{Z}$ is the mean of the explanatory variables.

For dummy variables, the marginal effects are calculated by evaluating the cell probabilities when the dummy variable takes alternative values and taking the difference of the two probabilities (Greene 1995).

The specification of the estimated land rights equation is:

$$R_{it+1} = \alpha_i + \omega k_{it} + \beta h_{it} + \eta x_{it} + \gamma R_{it} + \varepsilon_i \quad (6)$$

where α, ω, β, η, and γ, are parameters to be estimated and ε is the error term. The link between property rights and increased investment has been discussed widely in the literature. This study is not an attempt to provide evidence to the contrary, but seeks to extend the discussion to include potential effect of investment in defining property rights. However, if both arguments are empirically significant this will pose an econometric problem in estimating equation 6, because of the contemporaneous correlation of property rights and land improvements. In order to minimise the problem, some other variables are used that could be thought to determine property rights, perhaps proxying for investment. These variables include the quality of the land (soil fertility), the wealth of the household (measured by the number of cattle owned) and the educational attainment of the head of the household. Proxy variables are also used in place of R_{it}, which is not observed directly in the available data. The selected variables include, the

method of land acquisition, and the presence of land improvements at the time of acquisition.

The land improvements data come in discrete form: whether a particular improvement was undertaken on the field. Specifically, improvements were measured as a variable equal to one if improvement was undertaken since the field was acquired, and zero otherwise. The logit model was chosen for analysing the investment equation. The model is specified as:

$$k_{it} = \varphi_i + \lambda R_{it+1} + \theta h_{it} + \varphi x_{it} + \mu_i \quad (7)$$

where φ, λ, θ, and φ parameters to be estimated and μ is an error term.

Results of the Econometric Analysis

The results from estimation of the rights equation are presented in Table 4-4. Larger farms appear less likely to have unrestricted transfer rights. Large farm size reduces the probability of having unrestricted rights to sale, rent or gift agricultural land. This may be a reflection of high costs of investing in tenure securing activities, for example, building a barbed fence around a large farm may be very costly for most communal lands farmers. However, this result seems to be in line with the theoretical discussion above, which suggests that level of costs of enforcing rights will influence an individual's decision whether or not to pursue their rights in land. Technological change and changes (leading to the availability of new and cheaper fencing materials) in laws regulating property rights may help to reduce the costs incurred by individuals in securing their land rights. Households with more adult female members are generally less likely to enjoy unrestricted transferability of land than other households.

An increase in household wealth (as measured by cattle ownership) increases the probability of acquiring unrestricted rights to gift land. A long period of land ownership increases the probability of having an unrestricted right to pledge without approval but reduces right to unrestricted land sale. These results seem to agree with the idea that rights are in transition, where possession of a field enhances the landholder's rights, and

the accumulation of wealth enables the landowner to engage in activities that generate higher returns but require a high initial capital outlay. Increases in wealth will also provide the resources required to investments in tenure securing activities. However, a long period of ownership also reduces the probability of a landholder having unrestricted rights to sell land.

Households in Chivi are less likely to enjoy unrestricted rights to sale, rent and gift agricultural land than households in Mangwende, but are more likely to be able to pledge, mortgage and bequeath their agricultural without needing approval by village authorities.

Table 4-4: Rights regression (Ordered Probit)

	Sale (t-stat.)	Rent (t-stat.)	Bequeath (t-stat.)	Gift (t-stat.)	Mortgage (t-stat.)	Pledge (t-stat.)
Constant	.60	.50	.17	.822	-.59	-.13
	(1.47)	(1.26)	(.43)	(2.25)**	(1.44)	(.31)
Age of household head	.12	.09	.00	.109	.05	-.09
	(1.93)*	(1.39)	(.00)	(1.82)	(.75)	(1.27)
No. of adult females	-.06	-.14	.016	-.10	-.04	-.25
	(1.03)	(2.25)**	(.30)	(1.93)*	(.76)	(2.80)**
No. of adult males	-.01	-.01	.015	.01	.05	.03
	(.17)	(.29)	(.27)	(.31)	(1.09)	(.61)
Education level of head	-.06	-.03	.19	.02	.02	.02
	(.66)	(.31)	(1.92)**	(.20)	(.18)	(.14)
Number of cattle	.01	.02	-.00	.028	.02	.01
	(.55)	(1.77)*	(.24)	(2.03)**	(1.27)	(1.01)
Years land owned	-.01	-.00	-.01	-.00	.06	.01
	(3.31)**	(.99)	(1.57)	(.86)	(1.57)	(2.23)**
Land inherited	.34	.19	.17	.312	.07	-.01
	(1.83)*	(1.11)	(.92)	(1.87)	(.39)	(.51)
Land allocated	.04	.00	.03	.17	.12	-.07
	(.22)	(.02	(.17)	(1.06)	(.661)	(.40)
Field area	-.13	-.15	.04	-.09	-.164	.01
	(7.03)**	(9.19)**	(1.66)*	(6.52)**	(.661)	(4.90)**
Soil quality	0.1	.15	.09	-.05	.057	.05
	(1.16)	(1.80)*	(1.11)	(.60)	(.667)	(.49)
Existing contour ridges	-.15	-.17	-.20	-.10	-.016	-.17
	(1.31)	(1.53)	(1.74)*	(.92)	(.145)	(1.47)
Dummy variable	-.53	-.63	1.32	-.78	0.40	.68
(Chivi = 1)	(4.52)**	(5.51)**	(10.30)**	(7.27)**	(3.47)**	(5.40)**
μ	1.50	.87	1.39	1.16	.97	1.18
	(17.91)**	(14.90)**	(13.99)**	(18.52)**	(14.40)**	(14.52)**
$\chi^{2\,a}$	80.99	92.74	174.03	83.87	96.34	95.63
% correct prediction	.61	.53	.62	.51	.63	.71

** significant at the 5% level, * significant at the 10% level

Since the coefficients of the ordered probit model do not have the same interpretation as a change in the value of the dependent variable as a result of a marginal change in the explanatory variable (*ceteris paribus*), marginal effects were calculated separately. The marginal effects of some selected variable are given in Table 4-5. The results indicate that an increase in household wealth increases the probability of having unrestricted rights to transfer land rights. An increase in wealth (number of cattle) increases the probability of acquiring unrestricted rights to transfer land.

In general, an increase in area of field decreases the probability of having unrestricted rights to sale, rent, gift and to mortgage the land (the negative sign on the probability for cell 3 – probability (y = 2) = 0). This result appears to be in line with the view that at current prices and level of technology farmers with larger farm sizes find it too costly to invest in tenure securing activities.

Table 4-5: Marginal probabilities of selected variables (Ordered Probit Model)

	Rights					
Variable	Sale	Rent	Bequeath	Gift	Mortgage	Pledge
Field Size						
Prob(y = 0)	0.0504	0.0589	-0.0126	0.0230	0.0543	-0.0040
Prob(y = 1)	-0.0389	-0.0207	0.0002	0.0120	0.0046	0.0018
Prob(y = 2)	-0.0114	-0.0382	0.0125	-0.0351	-0.0589	0.0022
Number of years owned						
Prob(y = 0)	0.0039	-0.0013	0.0032	0	-0.0204	-0.0040
Prob(y = 1)	-0.0030	0.0005	-0.00004	0	-0.0017	0.0022
Prob(y = 2)	-0.0009	0.0009	-0.0031	0	0.0221	0.0018
Cattle						
Prob(y = 0)	-0.0039	-0.0084	0	-0.0077	-0.0068	-0.004
Prob(y = 1)	0.0030	0.0030	0	-0.0040	-0.0006	0.0022
Prob(y = 2)	0.0009	0.0054	0	0.0117	0.0074	0.0018
Dummy (Chivi =1)						
Prob(y = 0)	0.0084	0.0186	0.3218	0.1394	0.0379	-0.0066
Prob(y = 1)	-0.0657	-0.1042	-0.2685	-0.1842	-0.0303	-0.0974
Prob(y = 2)	0.0573	0.0856	-0.0533	0.0448	-0.0076	0.1039

Two indices measuring the rights held by a farmer over his/ her agricultural land were generated and included in the investments equation. The indices are obtained by summing the number of restricted and unrestricted rights, respectively, held by a landholder over his/ her agricultural land. The results of estimating the investment equation are shown in Table 4-6. In line with theory, rights matter for investment in contour ridges, in tied-ridges and in fences. An extra right with approval will increase the probability of investing in contour ridges and tied-ridges; and an extra right without

approval will increase the probability of investing in contour ridges and fences. Contour ridges are likely to be constructed by households that have owned their land for longer periods of time. Having acquired a field with contour ridges increases the probability of investing in contours ridges, presumably because it is easier to make the decision if such improvements had been made before. Investments in contour ridges, tied-ridges and fences appear to be complimentary to livestock. A larger field reduces the probability of investing in fences, but increases the probability of having contour ridges and tied-ridges. Population density increases the probability of fencing off land.

The significance of rights for investment does not rule out the possibility that rights are endogenous. The different ways in which rights are measured in the endogenous rights model and in the investments model may be one of the reasons why the findings in the two models appear contradictory.

Table 4-6: New investments (Logit)

	Contour ridges (t-statistic)	Manuring (t-statistic)	Fencing (t-statistics)	Tied-ridges (t-statistic)
Constant	-.20 (.24)	-.18 (.23)	-2.65 (3.29)**	1.8 (2.1)**
Rights with approval	.02(3.89)**	.02 (.5)	.01 (.17)	.09 (2.206)**
Rights without approval	.08 (1.38)	.32 (.59)	.13 (2.45)**	.02 (.39)
Age of household head	.14 (1.92)*	-.01 (.15)	-.05 (.7)	-.03 (.37)
Education of head	.10 (.93)	-.14 (.15)	.2 (2.09)**	.02 (.21)
Number of adult females	-.04 (.52)	-.03 (.42)	.06 (.95)	-.29 (3.82)**
Number of adult males	.03 (.51)	.17 (3.06)**	.04 (.72)	-.03 (.51)
Related to *sabhukul* chief	-.20 (1.45)	-.19 (1.45)	.21 (1.61)	.07 (.48)
Number of cattle	.02 (1.56)	.12 (7.38)**	.05 (3.79)**	.03 (2.15)**
Field area	.06 (2.18)**	-.02 (.67)	-.05 (2.22)**	.06 (2.36)**
Years owned	.02 (4.18)**	.01 (2.14)*	.01 (1.82)*	.00 (.79)
Soil quality	-.10 (1.00)	-.12 (1.35)	.02 (.27)	.05 (.46)
Land inherited	.49 (2.39)**	.09 (.42)	-.22 (1.09)	.04 (.19)
Land allocated	.30 (1.56)	-.11 (.59)	.07 (.34)	-.25 (1.18)
Population density	-.01 (.52)	-.00 (.06)	.02 (2.09)**	-.05 (4.45)**
Existing contour ridges	.53 (4.08)**	-.21 (1.74)*	-.34 (2.69)**	.30 (1.20)
Existing planted trees	.10 (.54)	.29 (1.34)	.18 (.83)	-.28 (1.23)
χ^2	150.83 (.00)	133.75 (.00)	63.8 (.00)	304.97 (.00)
% correctly predicted	.77	.70	.67	.78

** significant and the 5% level, * significant at the 10% level

Summary and Conclusion

The study reported in this chapter is motivated by the need for better understanding the determinants of land rights as well as their consequences, which will facilitate the design of effective land rights reforms. Property rights guide incentives to achieve efficient and sustainable use of resources. However, like other institutional structures of society, property rights are not static. It is argued that property rights change over time as a result of economic agents' responses to changes in technology and in resource endowments.

A model of endogenous land rights was developed and applied to sample survey data from the communal lands in Zimbabwe. The evidence, although somewhat weak, suggests that land rights in the communal areas are in transition, away from a communal system of land tenure towards more individualised land rights.

The results of the analysis suggest that high costs of defining and enforcing property rights, as represented by the size of a household's agricultural land, may impede the evolution of land rights towards more individualized holdings, while increases in wealth may enhance the process. That land rights may evolve in response to changes in socio-economic circumstances, may have importance for policy analysis.

In current efforts of land reform, governments may want to consider the local context of tenure evolution. Evidence suggests that there may be currently a trend towards more specific definitions of property rights as rights become more individualized, especially if local economies develop to provide households with more wealth. Therefore, the current desire of land reform to more clearly specify land rights could be facilitated by this process. Furthermore, this process could be aided with policies that aim at reducing costs of tenure definition. For example, the subsidization of products that aid in property definition, such as fencing materials could perhaps cause more individualized holdings to arise.

Although the present study is based on the concept that increased incentives for defining and specifying property rights arise from increased land values, future research may further increase our understanding of the evolutionary changes in land tenures by

examining the productivity effects (e.g., increases in the value of cattle and crop production) of well-defined land rights..

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CHAPTER 5

Conclusions and Summary

There exist in many cases close links between household level and aggregate (village, and national) economic processes. For example, household saving behaviour is closely linked to national savings rates, and ultimately to economic growth and economic development. Also, local resource use decisions can have impacts felt beyond the village. For example, decisions by households to expand agricultural land can contribute to deforestation and its attendant consequences. Understanding the determinants of household behaviour is, thus, important for understanding processes such as economic growth and development. The study of household behaviour also helps the understanding of how households deal with economic problems (e.g., how households deal with income fluctuations or how behaviour is used influences changes in institutions). A better understanding of household behaviour will sharpen our understanding of causes of outcomes, which will lead to the design of better economic policies.

The research reported in this dissertation uses microeconomic-theoretic frameworks to evaluate empirical phenomena observed among rural household in developing countries in order to uncover any underlying behavioural patterns, and to generate some knowledge that can be used to inform economic policies intended to affect this group of economic agents. The theoretical approaches used to underpin the studies are chosen for their consistency with general observations, and their ability to generate hypothesises that can be tested using data obtained from samples of real households.

In the first study, reported in Chapter 2, the objective is to provide estimates of private rates of time preference of rural households and to investigate the determinants of the estimated rates of time preference. While economists typical use data generated in markets to study the behaviour of economic agents, the general lack of markets in rural communities of many developing countries makes it impossible to rely on this approach in many cases. An empirical method that involves offering respondents series of binary choices between a specified amount of a good (maize or firewood) to be received now and alternative amounts to be received at a later date, is used to elicit and calculate

individual's rates of time preference. The results reveal that the rates of time preference implicit in individual's intertemporal consumption decisions are quite high. A possible reason for the high RTPs is that they reflect to some degree, individuals' risk perceptions, even though attempts were made to emphasise the certainty of promised future consumption during the surveys. Rates of time preference are found to generally increase with the length of the time delay, were on average higher for firewood than for maize, and varied substantially among different groups of individuals.

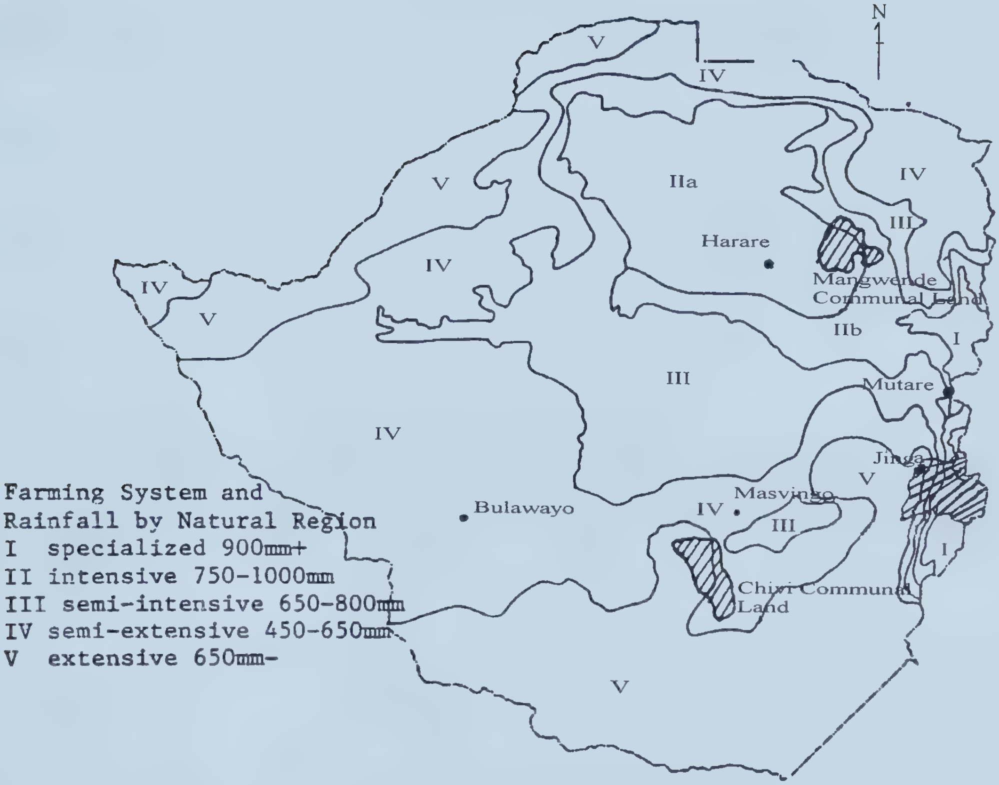
This study contributes some empirical evidence to the discussion of the rates of time preference of agricultural households in developing countries and their consequences. The type of research described here may also have direct policy applications by conducted measurement of rates of time preference within the context of a specific policy or project, for example tree planting or soil conservation projects.

In Chapter 3, the objective is to understand how households deal with fluctuations to their income, and to explore the role of cattle as a buffer stock. The majority of people in developing countries are engaged in agriculture, and their livelihoods are subject to great uncertainty, from weather calamities, from price fluctuations and from sickness. Households may employ a number of mechanisms, including the sale of cattle, to help "smooth" their consumption when their incomes are temporarily low. The study reported in Chapter 3 explores the empirical significance of cattle sales as a consumption smoothing tool, through the construction of a model of household asset accumulation behaviour under conditions of income risk and borrowing constraints/ where self-insurance is one of the objectives of the household. The results from the empirical estimation of the model using sample household data from the communal areas in Zimbabwe show a weak relationship between drought-induced income fluctuations and cattle sales, suggesting that cattle sales play only a small role in helping smooth consumption when there is a shock to household income.

The study presented in Chapter 4 explores the process by which institutional changes are induced, through the response of economic agents to changes in resource endowments and to changes in supply and demand of factors and products, by focusing on responses of farmers to increases in land values due to scarcity, to opening of markets and to technical innovations. A model linking technical change, and changes in the socio-

economic environment and increases in land values, is developed and underpins the discussion of the demand for individualised land rights among communal lands farmers. A formal model of endogenous property rights is presented and used to explore the determinants of the land rights enjoyed by farmers in the communal lands in Zimbabwe. The results of estimating the model provides only some weak evidence of a transition in land rights, probably because the process may be still only nascent.

APPENDIX A
Map of Zimbabwe



Source: Adapted from D.D. Rohrbach (1987)

APPENDIX B

QUESTIONNAIRE: RATES OF TIME PREFERENCE SURVEY

Household Name Household Code

Interviewer's Name

Starting time

SECTION 1

We would like to ask a few questions about yourself and your household. These questions are important because they will help us understand how different people value maize and fuel would. Yours answers to these questions will be treated confidentially.

1. Gender of respondent (Observed)

   1. Male **2**. Female

2. In which of the following categories does your age (in years) fall? (Please mark response with a circle).

   1. 15 - 25 **2**. 26 – 35 **3**. 36 – 45

   4. 46 – 55 **5**. 56 – 65 **6**. 66+

3. How many head of cattle does your household have?

4. How many goats does your household have?

5. How many people are in your household? (Including members working in towns, cities, etc.)

   Children (< 18 years)

   Adults (18 years +)

6. What is the highest level of education you have completed? (Please mark response)

1. No formal education
2. Primary school (grade 1/ sub A to grade &/ standard 6)
3. Junior certificate (JC – form 1 to 2)
4. Ordinary level ("O" level – form 3 to 4)
5. Trade school, technical, teachers' nursing college
6. University

7. What is the price (in Z$) of a:

Bucket of maize?

Head of fuelwood?

SECTION II (Version 1) (Use Table[1] 1 – 6)

Maize 1 Year ---- 0%, 5%, 10%, 20%, 40%, 60%

Following are some questions in which you are asked to choose between varying quantities of maize. (RESPONDENTS MAY CHANGE THEIR RESPONSES TO PREVIOUS QUESTIONS)

Question 1
Suppose you were one of the people who volunteered to help on a donor agency funded school construction project. The project has just been successfully completed. In appreciation the donor agency is offering you a choice to receive 10 buckets of maize now or you can choose to receive 10 buckets of maize 1 year from now. You can only choose one of the options. We emphasise that these are hypothetical choices and are not being considered as a future project plan by any donor or government agency. Assume you and the donor agency will have a legally binding agreement that ensures that you or any member of your family is guaranteed to receive the maize at the time you choose to collect it. Which would you choose (SHOW TABLE 1. Please mark answer with a circle):

A. 10 buckets of maize now **B**. 10 buckets 1 year from now

Question 2
Now suppose the Donor Agency is offering you a choice between 10 buckets of maize now or you can choose to receive 10.5 buckets of maize 1 year from now. Which would you choose? (SHOW TABLE 2)

A. 10 buckets of maize now **B**. 10.5 buckets of maize 1 year from now

Question 3
Now suppose the Donor Agency is offering you a choice between 10 buckets of maize now or you can choose to receive 11 buckets of maize 1 year from now. Which would you choose? (SHOW TABLE 3)

A. 10 buckets of maize now **B**. 11 buckets of maize 1 year from now

Question 4
Now suppose the Donor Agency is offering you a choice between 10 buckets of maize now or you can choose to receive 12 buckets of maize 1 year from now. Which would you choose? (SHOW TABLE 4)

A. 10 buckets of maize now **B**. 12 buckets of maize 1 year from now

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[1] The tables were used as props designed to help improve respondents' understanding of the experiment by providing a visual representation of the quantities (in the form of squares drawn on a sheet of paper) involved in the trade-offs implied in each question

Question 5
Now suppose the Donor Agency is offering you a choice between 10 buckets of maize now or you can choose to receive 11 buckets of maize 1 year from now. Which would you choose? (SHOW TABLE 5)

A. 10 buckets of maize now **B**. 14 buckets of maize 1 year from now

Question 6
Now suppose the Donor Agency is offering you a choice between 10 buckets of maize now or you can choose to receive 16 buckets of maize 1 year from now. Which would you choose? (SHOW TABLE 6)

A. 10 buckets of maize now **B**. 16 buckets of maize 1 year from now

ARE THERE SOME RESPONSES TO THE ABOVE QUESTIONS THAT YOU WOULD WANT TO CHANGE?

Time at end of interview

SECTION II (Version 2) (Use Table 7 – 12)

Maize 5 Year2 ---- 0%, 5%, 10%, 20%, 40%, 60%

Following are some questions in which you are asked to choose between varying quantities of maize. (IN THIS SECTION RESPONDENTS MAY GO BACK AND CHANGE THEIR RESPONSES TO PREVIOUS QUESTIONS)

Question 1
Suppose you were one of the people who volunteered to help a donor agency funded school construction project. The project has just been successfully completed. In appreciation the donor agency is offering you a choice to receive 10 buckets of maize now or you can choose to receive 10 buckets of maize 5 years from now. You can only choose one of the options. We emphasise that these are hypothetical choices and are not being considered as a future project plan by any donor or government agency. Assume you and the donor agency will have a legally binding agreement that ensures that you or any member of your family is guaranteed to receive the maize at the time you choose to collect it. Which would you choose (SHOW TABLE 7. Please mark answer with a circle):

A. 10 buckets of maize now **B**. 10 buckets 5 years from now

Question 2
Now suppose the Donor Agency is offering you a choice between 10 buckets of maize now or you can choose to receive 13 buckets of maize 5 years from now. Which would you choose? (SHOW TABLE 8)

A. 10 buckets of maize now **B**. 13 buckets of maize 5 years from now

Question 3
Now suppose the Donor Agency is offering you a choice between 10 buckets of maize now or you can choose to receive 11 buckets of maize 5 years from now. Which would you choose? (SHOW TABLE 9)

A. 10 buckets of maize now **B**. 16 buckets of maize 5 years from now

Question 4
Now suppose the Donor Agency is offering you a choice between 10 buckets of maize now or you can choose to receive 16 buckets of maize 5 years from now. Which would you choose? (SHOW TABLE 10)

A. 10 buckets of maize now **B**. 25 buckets of maize 5 years from now

Question 5
Now suppose the Donor Agency is offering you a choice between 10 buckets of maize now or you can choose to receive 54 buckets of maize 5 years from now. Which would you choose? (SHOW TABLE 11)

A. 10 buckets of maize now **B**. 54 buckets of maize 5 years from now

Question 6
Now suppose the Donor Agency is offering you a choice between 10 buckets of maize now or you can choose to receive 105 buckets of maize 5 years from now. Which would you choose? (SHOW TABLE 12)

A. 10 buckets of maize now **B**. 105 buckets of maize 5 years from now

ARE THERE SOME RESPONSES TO THE ABOVE QUESTIONS THAT YOU WOULD WANT TO CHANGE?

Time at end of interview

SECTION II (Version 3) (Use Table 13 – 18)

Maize 10 Years ---- 0%, 5%, 10%, 20%, 40%, 60%

Following are some questions in which you are asked to choose between varying quantities of maize. (IN THIS SECTION RESPONDENTS MAY GO BACK AND CHANGE THEIR RESPONSES TO PREVIOUS QUESTIONS)

Question 1
Suppose you were one of the people who volunteered to help a donor agency funded school construction project. The project has just been successfully completed. In appreciation the donor agency is offering you a choice to receive 10 buckets of maize now or you can choose to receive 10 buckets of maize 10 years from now. You can only choose one of the options. We emphasise that these are hypothetical choices and are not being considered as a future project plan by any donor or government agency. Assume you and the donor agency will have a legally binding agreement that ensures that you or any member of your family is guaranteed to receive the maize at the time you choose to collect it. Which would you choose (SHOW TABLE 13. Please mark answer with a circle):

A. 10 buckets of maize now **B**. 10 buckets 10 years from now

Question 2
Now suppose the Donor Agency is offering you a choice between 10 buckets of maize now or you can choose to receive 16 buckets of maize 10 years from now. Which would you choose? (SHOW TABLE 14)

A. 10 buckets of maize now **B**. 16 buckets of maize 10 years from now

Question 3
Now suppose the Donor Agency is offering you a choice between 10 buckets of maize now or you can choose to receive 11 buckets of maize 10 years from now. Which would you choose? (SHOW TABLE 3)

A. 10 buckets of maize now **B**. 26 buckets of maize 10 years from now

Question 4
Now suppose the Donor Agency is offering you a choice between 10 buckets of maize now or you can choose to receive 26 buckets of maize 10 years from now. Which would you choose? (SHOW TABLE 16)

A. 10 buckets of maize now **B**. 62 buckets of maize 10 years from now

Question 5
Now suppose the Donor Agency is offering you a choice between 10 buckets of maize now or you can choose to receive 289 buckets of maize 10 years from now. Which would you choose? (SHOW TABLE 17)

A. 10 buckets of maize now **B**. 289 buckets of maize 10 years from now

Question 6
Now suppose the Donor Agency is offering you a choice between 10 buckets of maize now or you can choose to receive 16 buckets of maize 10 years from now. Which would you choose? (SHOW TABLE 18)

A. 10 buckets of maize now **B**. 1100 buckets of maize 10 years from now

ARE THERE SOME RESPONSES TO THE ABOVE QUESTIONS THAT YOU WOULD WANT TO CHANGE?

Time at end of interview

SECTION II (Version 1V) (Use Table 1 – 6)

Fuelwood 1 Year ---- 0%, 5%, 10%, 20%, 40%, 60%

Following are some questions in which you are asked to choose between varying quantities of maize. (RESPONDENTS MAY CHANGE THEIR RESPONSES TO PREVIOUS QUESTIONS)

Question 1
Suppose you were one of the people who volunteered to help on a donor agency funded school construction project. The project has just been successfully completed. In appreciation the donor agency is offering you a choice to receive 10 headloads of fuelwood now or you can choose to receive 10 headloads of fuelwood 1 year from now. You can only choose one of the options. We emphasise that these are hypothetical choices and are not being considered as a future project plan by any donor or government agency. Assume you and the donor agency will have a legally binding agreement that ensures that you or any member of your family is guaranteed to receive the fuelwood maize at the time you choose to collect it. Which would you choose (SHOW TABLE 1. Please mark answer with a circle):

A. 10 headloads of fuelwood now **B**. 10 headloads of fuelwood 1 year from now

Question 2
Now suppose the Donor Agency is offering you a choice between 10 headloads of fuelwood now or you can choose to receive 10.5 headloads of fuelwood 1 year from now. Which would you choose? (SHOW TABLE 2)

A. 10 headloads of fuelwood now **B**. 10.5 headloads of fuelwood 1 year from now

Question 3
Now suppose the Donor Agency is offering you a choice between 10 headloads of fuelwood now or you can choose to receive 11 headloads of fuelwood 1 year from now. Which would you choose? (SHOW TABLE 3)

A. 10 headloads of fuelwood now **B**. 11 headloads of fuelwood 1 year from now

Question 4
Now suppose the Donor Agency is offering you a choice between 10 headloads of fuelwood now or you can choose to receive 12 headloads of fuelwood 1 year from now. Which would you choose? (SHOW TABLE 4)

A. 10 headloads of fuelwood now **B**. 12 headloads of fuelwood 1 year from now

Question 5
Now suppose the Donor Agency is offering you a choice between 10 headloads of fuelwood now or you can choose to receive 11 headloads of fuelwood 1 year from now. Which would you choose? (SHOW TABLE 5)

A. 10 headloads of fuelwood now   **B**. 14 headloads of fuelwood 1 year from now

Question 6
Now suppose the Donor Agency is offering you a choice between 10 headloads of fuelwood now or you can choose to receive 16 headloads of fuelwood 1 year from now. Which would you choose? (SHOW TABLE 6)

A. 10 headloads of fuelwood now   **B**. 16 headloads of fuelwood 1 year from now

ARE THERE SOME RESPONSES TO THE ABOVE QUESTIONS THAT YOU WOULD WANT TO CHANGE?

Time at end of interview

SECTION II (Version V) (Use Table 7 – 12)

Fuelwood 5 Years ---- 0%, 5%, 10%, 20%, 40%, 60%

Following are some questions in which you are asked to choose between varying quantities of maize. (IN THIS SECTION RESPONDENTS MAY GO BACK AND CHANGE THEIR RESPONSES TO PREVIOUS QUESTIONS)

Question 1
Suppose you were one of the people who volunteered to help a donor agency funded school construction project. The project has just been successfully completed. In appreciation the donor agency is offering you a choice to receive 10 headloads of fuelwood now or you can choose to receive 10 headloads of fuelwood 5 years from now. You can only choose one of the options. We emphasise that these are hypothetical choices and are not being considered as a future project plan by any donor or government agency. Assume you and the donor agency will have a legally binding agreement that ensures that you or any member of your family is guaranteed to receive the fuelwood at the time you choose to collect it. Which would you choose (SHOW TABLE 7. Please mark answer with a circle):

A. 10 headloads of fuelwood now **B**. 10 headloads of fuelwood 5 years from now

Question 2
Now suppose the Donor Agency is offering you a choice between 10 headloads of fuelwood now or you can choose to receive 13 headloads of fuelwood 5 years from now. Which would you choose? (SHOW TABLE 8)

A. 10 headloads of fuelwood now **B**. 13 headloads of fuelwood 5 years from now

Question 3
Now suppose the Donor Agency is offering you a choice between 10 headloads of fuelwood now or you can choose to receive 11 headloads of fuelwood 5 years from now. Which would you choose? (SHOW TABLE 9)

A. 10 headloads of fuelwood now **B**. 16 headloads of fuelwood 5 years from now

Question 4
Now suppose the Donor Agency is offering you a choice between 10 headloads of fuelwood now or you can choose to receive 16 headloads of fuelwood 5 years from now. Which would you choose? (SHOW TABLE 10)

A. 10 headloads of fuelwood now **B**. 25 headloads of fuelwood 5 years from now

Question 5
Now suppose the Donor Agency is offering you a choice between 10 headloads of fuelwood now or you can choose to receive 54 headloads of fuelwood 5 years from now. Which would you choose? (SHOW TABLE 11)

A. 10 headloads of fuelwood now **B**. 54 headloads of fuelwood 5 years from now

Question 6
Now suppose the Donor Agency is offering you a choice between 10 headloads of fuelwood now or you can choose to receive 105 headloads of fuelwood 5 years from now. Which would you choose? (SHOW TABLE 12)

A. 10 headloads of fuelwood now **B**. 105 headloads of fuelwood 5 years from now

ARE THERE SOME RESPONSES TO THE ABOVE QUESTIONS THAT YOU WOULD WANT TO CHANGE?

Time at end of interview

SECTION II (Version VI) (Use Table 13 – 18)

Fuelwood 10 Years ---- 0%, 5%, 10%, 20%, 40%, 60%

Following are some questions in which you are asked to choose between varying quantities of maize. (IN THIS SECTION RESPONDENTS MAY GO BACK AND CHANGE THEIR RESPONSES TO PREVIOUS QUESTIONS)

Question 1
Suppose you were one of the people who volunteered to help a donor agency funded school construction project. The project has just been successfully completed. In appreciation the donor agency is offering you a choice to receive 10 headloads of fuelwood now or you can choose to receive 10 headloads of fuelwood 10 years from now. You can only choose one of the options. We emphasise that these are hypothetical choices and are not being considered as a future project plan by any donor or government agency. Assume you and the donor agency will have a legally binding agreement that ensures that you or any member of your family is guaranteed to receive the fuelwood at the time you choose to collect it. Which would you choose (SHOW TABLE 13. Please mark answer with a circle):

A. 10 headloads of fuelwood now **B**. 10 headloads of fuelwood 10 years from now

Question 2
Now suppose the Donor Agency is offering you a choice between 10 headloads of fuelwood now or you can choose to receive 16 headloads of fuelwood 10 years from now. Which would you choose? (SHOW TABLE 14)

A. 10 headloads of fuelwood now **B**. 16 headloads of fuelwood 10 years from now

Question 3
Now suppose the Donor Agency is offering you a choice between 10 headloads of fuelwood now or you can choose to receive 11 headloads of fuelwood 10 years from now. Which would you choose? (SHOW TABLE 3)

A. 10 headloads of fuelwood now **B**. 26 headloads of fuelwood 10 years from now

Question 4
Now suppose the Donor Agency is offering you a choice between 10 headloads of fuelwood now or you can choose to receive 26 headloads of fuelwood 10 years from now. Which would you choose? (SHOW TABLE 16)

A. 10 headloads of fuelwood now **B**. 62 headloads of fuelwood 10 years from now

Question 5
Now suppose the Donor Agency is offering you a choice between 10 headloads of fuelwood now or you can choose to receive 289 headloads of fuelwood 10 years from now. Which would you choose? (SHOW TABLE 17)

A. 10 headloads of fuelwood now **B**. 289 headloads of fuelwood 10 years from now

Question 6
Now suppose the Donor Agency is offering you a choice between 10 headloads of fuelwood now or you can choose to receive 16 headloads of fuelwood 10 years from now. Which would you choose? (SHOW TABLE 18)

A. 10 headloads of fuelwood now **B**. 1100 headloads of fuelwood 10 years from now

ARE THERE SOME RESPONSES TO THE ABOVE QUESTIONS THAT YOU WOULD WANT TO CHANGE?

Time at end of interview

APPENDIX C

Questionnaire: Economic Behaviour of Households in the Communal Lands in Zimbabwe

University of Alberta, Department of Rural Economy

Ward ---------------------------- Village ---------------------------------------

Natural Region ----------------- Communal Area ----------------------------

Household name ---------------- Household code ----------------------------

Interviewer's name ------------ Date of Interview --------------------------

Starting Time ------------------- Finishing Time -----------------------------

Many households in the communal areas of Zimbabwe engage in agro-pastoral activities (the production of crops and raising of livestock) as their main source of livelihood. Since independence in 1980, many agencies have been involved in helping farmers in the communal areas to improve their productivity in a bid to raise the standard of living of the majority of the population of Zimbabwe. However, to be effective more information is needed about the processes and ways in which production and land use decisions are made by farmers. A researcher, Godfrey Kundhlande, from the University of Alberta in Canada would want to find out more about how farmers decide to buy or sell livestock (particularly cattle and goats), and the factors that influence decisions to carry out improvements on agricultural land. In doing this work Godfrey will be assisted by a group of research assistant comprising of people from your area. To help us understand farmers' decisions making processes we would like to ask you some questions.

Section A: Household Characteristics

The following questions are designed to tell us a little bit about you and your household. This information is important because it will allow us to compare and understand livestock husbandry practices and land use decisions of different groups of people. The information will be treated as confidential. Your name will never appear with your answers. Only a summary of the results will be publicised.

1. Sex of respondent (***Observed - please circle appropriate answer***)

01 = Female **02** = Male

2. In which of the following categories does your age (years) fall?

01. 18 - 29 **02**. 30 - 40 **03**. 40 - 50 **04**. over 50

3. What is the highest level of education that you have completed?

01 = no formal education **02** = primary **03** = secondary

04 = technical, teachers', nursing or other college **05** = university

4. Is the head of the household a Master Farmer?

01 = No **02** = in training to become Master Farmer **03** = Yes

If Yes, what year were you certified? -------------------

5. Was any member of the household engaged in off-farm employment in the years indicated below? Please fill in the table.

Name of household member	Year					Type of job
	1992	1993	1994	1995	1996	
	01 = No **02** = Yes	**01** = No **02** = Yes	**01** = No **02** = Yes	**01** = No **02** = Yes	**01** = No **02** = Yes	**01** = shop assistant **02** = farm/ mine labourer **03** = works for local/ government **04** = teacher **05** = Other (**specify**) ----------------------

6. How many people are in your household (**including head of household**)? ---------
(**Please fill-in the table below**)

Name	Age (years) **01** = =<18 **02** = 18 - 29 **03** = 30 - 50 **04** = >50	Sex **01** = Female **02** = Male	Resident (**= > 6 months per year**) **01** = yes **02** = no

7. How long has the household been resident in this village? ---------------- **years**.

8. Where did you (household) reside previously? (**Describe if outside present village**)
----

9. Is the head of the household related to the chief/ *sabhuku*? (***Circle the appropriate response***)

01 = No **02** = Yes

If Yes, describe the relationship ---

10. Is the head of the household related to the VIDCO chairman? (***Circle the appropriate response***)

01 = No **02** = Yes

If Yes, describe the relationship ---

11. How many of the following assets does your household own?

Asset	Quantity (**number in working condition**)
Cart	
Plough	
Cultivator	

12. What is the status of the main house/ hut? (***Observe - please circle appropriate answer***).

01 = pole, dagga and thatch 02 = brick and thatch

03 = pole, dagga and modern roofing

04 = brick and modern roofing 05 = other (specify) -----------------

Section B: Livestock Inventory and Transactions

In this section we are asking for some information about the livestock owned by your household. This information will only be used for the purposes of this study, and when we write the results of our study, your name will not appear with your answers.

13. Please fill in the table below concerning the cattle you owned in 1992.

Type of Cattle	No. owned on New Year Day 1992	No. of deaths in 1992	No. sold in 1992	Reason for sale	No. bought in 1992	Reason for buying	No. of births	No. recieved as gifts	No gifted away
Cows				01 = buy grain 02 = school fees 03 = health care expenses 04 = lobola 05 = drought 06=Other (specify) -----------		01 = increase herd 02 = herd establishment 03 =fattening 04 = Other (specify) -----------			
Calves (< 1 year)							NA		
Heifers (1-3 years)							NA		
Steers (1- 3 years)							NA		
Oxen (> 3 years, castrated)							NA		
Bulls (>3 years)							NA		

14. Please fill in the table below concerning the cattle you owned during 1993.

Type of Cattle	No. owned on New Year Day 1993	No. of dea-ths in 1993	No. sold in 1993	Reason for sale	No. bou-ght in 1993	Reason for buying	No. of bir-ths in 1993	No. receiv -ed as gifts in 1993	No. gifted away in 1993
Cows				01 = buy grain 02 = school fees 03 = health care expenses 04 = lobola 05 = drought 06=Other (specify) -----------------		01 = increase herd 02 = herd establishment 03 = fattening 04=Other (specify) ---------------			
Calves (< 1 year)							NA		
Heifers (1-3 years)							NA		
Steers (1- 3 years)							NA		
Oxen (> 3 years, castrated)							NA		
Bulls (>3 years)							NA		

15. Please fill in the table concerning the cattle you owned in 1994.

Type of Cattle	No. owned on New Year Day 1994	No deaths in 1994	No. sold in 1994	Reason for sale	No. bought in 1994	Reason for buying	No. of births in 1994	No received as gifts in 1994	No. gifted away in 1994
Cows				01 = buy grain 02 = school fees 03 = health care expenses 04 = lobola 05 = drought 06=other (specify) -----------------		01 = increase herd 02 = herd establishment 03 = fattening 04=Other (specify) ---------------			
Calves (< 1 year)							NA		
Heifers (1-3 years)							NA		
Steers (1- 3 years)							NA		
Oxen (> 3 years, castrated)							NA		
Bulls (>3 years)							NA		

16.Please fill in the table below concerning the cattle you owned during 1995.

Type of Cattle	No. owned on New Year Day 1995	No. of deaths in 1995	No. sold in 1995	Reason for sale	No. bought in 1995	Reason for buying	No. of births in 1995	No. receiv-ed as gifts in 1995	No. gifted away in 1995
Cows				01 = buy grain 02 = school fees 03 = health care expenses 04 = lobola 05 = drought 06 = Other (specify) ---------------		01 = increase herd 02 = herd establishment 03 = fattening 04 = Other (specify) ---------------			
Calves (< 1 year)							NA		
Heifers (1-3 years)							NA		
Steers (1- 3 years)							NA		
Oxen (> 3 years, castrated)							NA		
Bulls (>3 years)							NA		

17. Please fill in the table below concerning the cattle you owned in 1996.

Type of Cattle	No. owned on New Year Day 1996	No. of dea-ths in 1996	No. sold in 1996	Reason for sale	No. bou-ght in 1996	Reason for buying	No. of bir-ths in 199 6	No. receiv -ed as gifts in 1996	No. gifted away in 1996
Cows				01 = buy grain 02 = school fees 03 =health care expenses 04 = lobola 05 = drought 06 = Other (specify) --------------------		01 = increase herd 02 = herd establishment 03 = fattening 04 = Other (specify) ---------------			
Calves (< 1 year)							NA		
Heifers (1-3 years)							NA		
Steers (1- 3 years)							NA		
Oxen (> 3 years, castrated)							NA		
Bulls (>3 years)							NA		

18. Are you a member of a "grazing scheme"?

01 = No

02 = Yes

19. Please fill in the table below concerning the goats you owned in 1992.

Type of Livestock	No. owned on New Year Day 1992	No. of deaths in 1992	No. sold in 1992	Reason for sale	No. bought in 1992	Reason for buying	No. of births in 1992	No. received as gifts in 1992	No. gifted away in 1992
Goats				**01** = buy grain **02** = school fees **03** = health care expenses **04** = lobola **05** = Other (**specify**) ---------------		**01** = increase flock **02** = flock establishment **03** = Other (**specify**) ----------			

20. Please fill in the table below concerning the goats you owned in 1993.

Type of Livestock	No. owned on New Year Day 1993	No. of deaths in 1993	No. sold in 1993	Reason for sale	No. bought in 1993	Reason for buying	No. of births in 1993	No. received as gifts in 1993	No. gifted away in 1993
Goats				**01** = buy grain **02** = school fees **03** = health care expenses **04** = lobola **05** =Other (**specify**) ------------		**01** = flock growth **02** = flock establishment **03** = Other (specify) ----------			

21. Please fill in the table below concerning the goats you owned in 1994.

Type of Livestock	No. owned on New Year Day 1994	No. of deaths in 1994	No. sold in 1994	Reason for sale	No. bought in 1994	Reason for buying	No. of births in 1994	No. received as gifts in 1994	No. gifted away in 1994
Goats				**01** = buy grain **02** = school fees **03** = health care expenses **04** = lobola **05** = Other (**specify**) ----------------		**01** = flock growth **02** = flock establishment **03** =Other (**specify**) --------			

22. Please fill in the table below concerning the goats you owned in 1995.

Type of Livestock	No. owned on New Year Day 1995	No. of deaths in 1995	No. sold in 1995	Reason for sale	No. bought in 1995	Reason for buying	No. of births in 1995	No. received as gifts in 1995	No. gifted away in 1995
Goats				**01** = buy grain **02** = school fees **03** = health care expenses **04** = lobola **05** = Other (**specify**) -------------------		**01** = flock growth **02** = flock establishment **03** =Other (**specify**) -----------			

23. Please fill in the table below concerning the goats you owned in 1996.

Type of Live-stock	No. owned on New Year Day 1996	No. of deaths in 1996	No. sold in 1996	Reason for sale	No. bou-ght in 1996	Reason for buying	No. of births in 1996	No. received as gifts in 1996	No. gifted away in 1996
Goats				**01** = buy grain **02** = chool fees **03** = health care expenses **04** = lobola **05** = Other (**specify**) -------------------		**01** = flock growth **02** = flock establish-ment **03** =Other (**specify**) -----------			

Section C: Land Tenure, Investment and Crop Production

The questions in this section are designed to provide us some information concerning your agricultural and homestead land, and the types of activities that you carry out on your land.

24. Does your household 'own' agricultural land?
01 = Yes **02** = No

If Yes, please fill in the table below.

Field Number	Amount of land **(acres)**	Year acqu -ired	Method of acquisition	Distance from homestead **(km)**	Rights enjoyed	Soil quality
Field # 1 (main field)			**01** = Allocated by *sabhuku* **02** = Inheritance **03** = Gift **04** = Purchased **05** =Appropriated **06** = Other (specify) -------------------		**01** = Sell without approval **02** = Sell with approval **03** = Rent out without approval **04** = Rent out with approval **05** = Bequaeth without approval **06** = Bequaeth with approval **07** = Gift away without approval **08** = Gift away with approval **09** = Mortgage without approval **10** = Mortgage with approval **11** = Pledge without approval **12** = Pledge with approval **13** = prevent other villager's stock from grazing crop stubble	**01** = poor **02** =fertile **03** = very fertile
Field # 2						
Field # 3						

25. Which crops did you grow during the 1991/92 season?

Crop	Area (**acres**)	Method of land preparation (what was used for ploughing)	Fertiliser type & quantity	Yield (**bags**)	Sold (**bags**)	Retained (**bags**)
maize						
groundnuts						
sorghum						

26. Which crops did you grow in the 1992/93 season?

Crop	Area (**acres**)	Method of land preparation (what was used for ploughing)	Fertiliser type & quantity	Yield (**bags**)	Sold (**bags**)	Retained (**bags**)
maize						
groundnuts						
sorghum						

27. Which crops did you grow in the 1993/94 season?

Crop	Area (**acres**)	Method of land preparation (what was used for ploughing)	Fertiliser type & quantity	Yield (**bags**)	Sold (**bags**)	Retained (**bags**)
maize						
groundnuts						
sorghum						

28. Which crops did you grow in the 1994/95 season?

Crop	Area (**acres**)	Method of land preparation (what was used for ploughing)	Fertiliser type & quantity	Yield (**bags**)	Sold (**bags**)	Retained (**bags**)
maize						
groundnuts						
sorghum						

29. Which crops did you grow in the 1995/96 season?

Crop	Area (**acres**)	Method of land preparation (what was used for ploughing)	Fertiliser type & quantity	Yield (**bags**)	Sold (**bags**)	Retained (**bags**)
maize						
groundnuts						
sorghum						

30. Has the size of your agricultural land changed since independence in 1980? Please describe the changes, if any, in the table below.

Field Number	Amount of land at time of acquisition (**acres**)	Increment to land (**acres**)	Method by which land was expanded	Reduction in land (**acres**)	How land area decreased
Field # 1 (main)			**01** = Allocated by *sabhuku* **02** = Inheritance **03** = Gift **04** = Purchased **05** = Appropriated **06** = Other (**specify**) ----------------		**01** = acquired for by government **02** = Partitioned/ Inheritance **03** = dispossessed by village authorities **04** = Gifted away **05** = Other (**specify**) ---------------------
Field # 2					
Field # 3					

31. What type of improvements/ investments have you made on your agricultural land since you acquired the land? Please fill in the following table.

Field #	Improvements/ Investment since land was acquired	Type	Qty. of Improvement/ Investment since land was acquired	Reasons for Investment/ Improvement	Improvements on land at time of acquiring it
Field # 1 (main)	**01** = Fence **02** = Planting trees **03** = Contour ridges **04** = Well(s) **05** = Continuous manuring **06** = Destumping **07** = Ridges **08** = Others (specify) ---------------	**Fence** **01** = barbed wire **02** = mesh wire **03** = live trees **04** = tree branches **Trees** **01** = fruit **02** = other **Contours** **01** = Measured by Extension Worker **02** = Measured by you **Manuring** **01** = cattle manure **02** = compost manure **03** = leaf litter **04** = anthill soil	**Fence** No. of strands ------ Length --- **m** **Trees** No. of times you planted trees --------- **Contours** Total No. ---- Long ------- Medium ---- Short ------- **Well(s)** Number ------ **Manuring** ---carts every -------years	**01** = to secure claim to land **02** = to keep out animals **03** = conserve soil **04** = to enhance yield **05** = Other (specify) ------------	**01** = Fence **02** = Planted trees **03** = Contour ridges **04** =Continuously manured **05** = Well(s) **06** = Destumped **07** = None
Field # 2					
Field # 3					

32. What changes do you think are likely to happen to the amount of agricultural land farmed by your household 15 years from today?

01 = Increase **02** = Decrease **03** = No change

Please describe expected changes, if any, in the table below.

Expected change in agricultural land	Expected Magnitude of change	Method by which land may be acquired/ lost
Increase	**01** = small **02** = medium **03** = large (------------------ **acres**)	**01** = allocation by *sabhuku* **02** = gift **03** = inheritance **04** = purchase **05** = appropriation **06** = Other (**specify**) ------------------------
Decrease	**01** = small **02** = medium **03** = large (----------------- **acres**)	**01** = acquired by government **02** = gifted away **03** = dispossessed by village authorities **04** = lost after dispute with other villagers **05** = Other (**specify**) -----------------------------

33.Do you think there is anybody who can take away (dispossess) part or all of your agricultural land?

01 = No **02** = Yes

34. If yes, who do you think might be able to take away (dispossess) some of your agricultural land?

01 = other villagers (in a dispute) **02** = *sabhuku* **03** = chief

04 = district council **05** = Other (**specify**) --------------------------

35. How likely do you think it is, that you may lose some of your agricultural land in the next 15 years, starting from today?

01 = unlikely **02** = likely **03** = very unlikely

36. If for some reason your agricultural land was taken away (by government or village authorities) do you think they will compensate you for improvements made on the land?

01 = Yes **02** = No

37. If Yes, why do you think so? ---

Section D: Village Characteristics

38. How far is the nearest source for agricultural inputs (fertilisers, pesticides etc.)?

--------------------- **km**

39. How far is the nearest market for agricultural produce? ---------------- **km**

40. Distance to major road ------------------- **km**

41. Distance to nearest town/ city ------------ **km**

42. Village population density ------------------

43. Amount of rainfall received

Year	Rainfall (**mm**)
1990	
1991	
1992	
1993	
1994	
1995	
1996	